California Rapid Assessment Method

Condition Assessment for Permanente Creek NPDES Flow Study Plan

Prepared for:

Lehigh Hanson, Inc.

March 2018

Prepared by:

GEI Consultants

Consulting Engineers and Scientists

California Rapid Assessment Method

Condition Assessment for Permanente Creek NPDES Flow Study Plan

Prepared for:

Lehigh Hanson, Inc.
Lehigh Southwest Cement Company
24001 Stevens Creek Blvd.
Cupertino, CA 95014

Contact:

Ms. Erika Guerra
(408) 257-7476

Prepared by:

GEI Consultants, Inc.
2868 Prospect Park Drive, Suite 400
Sacramento, CA 95670

Contact:

Cindy Davis
(916) 631-4515

March 1, 2018

Project No.1704602

Table of Contents

Tables

Appendices

Abbreviations and Acronyms

AA	assessment area
Cal-IPC	California Invasive Plant Council
CDEC	California Data Exchange Center
cfs	cubic feet per second
CRAM	California Rapid Assessment Method
CWA	Clean Water Act
CWMW	California Wetlands Monitoring Workgroup
EPA	U.S. Environmental Protection Agency
gpm	gallons per minute
NRCS	Natural Resources Conservation Service
RDM	residual dry matter
SWRCB	State Water Resources Control Board
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Executive Summary

Lehigh Southwest Cement Company (Lehigh, the operator) and Hanson Permanent Cement, Inc. (Hanson, the landowner) (collectively referred to as Lehigh Hanson) recently completed constructing new water treatment facilities at the Permanente Quarry and Cement Plant, as required by the San Francisco Regional Water Quality Control Board (SFRWQCB) pursuant to a National Pollution Discharge Elimination System (NPDES) permit (Order No. R2-2014-0010 as amended by Order No. R2-2017-0030) and Cease and Desist Order (CDO) (Order No. R2-2014-0011 as amended by Order No. R2-2017-0031). The water treatment facilities are comprised of two identical treatment trains, located in different areas of the facility, referred to as the Final Treatment System Upper (with treatment facilities and discharge at the historical discharge location near Pond 4A, referred to herein as the Upper Discharge Location) and Final Treatment System Lower (with treatment facilities located north of the Cement Plant and discharge below the Cement Plant into the concrete lined channel, referred to herein as the Downstream Discharge Location). Via a July 2017 amendment to the NPDES Permit, Lehigh Hanson was authorized to discharge from either location to Permanente Creek; however, until Lehigh Hanson begins its planned habitat restoration in accordance with an approved Permanente Creek restoration project, and before Lehigh Hanson can permanently shift the entirety of discharge flows to the downstream discharge point into the concrete lined channel, Lehigh Hanson must evaluate whether any minimum flows in Permanente Creek between the upper and lower discharge points are necessary, and if so, ensure they are maintained, as necessary and consistent with operations, to protect existing aquatic habitat beneficial uses. Permit Provision VI.C.7 (Order R2-2017-0030) requires Lehigh Hanson to submit a Flow Study Plan to the SFRWQCB for this purpose, with the Flow Study Plan "…determin[ing] the minimum flow necessary to protect existing Permanent Creek aquatic habitat beneficial uses year-round and management measures to sustain such flows."

To assess the current conditions in Permanente Creek and determine the need for minimum flows, the California Rapid Assessment Method (CRAM) was used to assess the condition of aquatic resources along Permanente Creek at six in-stream monitoring stations (assessment areas or AAs), and the Downstream Discharge Location (37.31837 N, -122.08712 W), located approximately 1.8 miles downstream of the Upper Discharge Location. Permanente Creek was evaluated using metrics and submetrics grouped into four different attributes: buffer and landscape context, hydrology, physical structure, and biotic structure. While CRAM was developed to assess wetland habitat, rather than stream habitat, many of the same features are relevant to the analysis Lehigh Hanson was requested to undertake via the NPDES Permit amendment, and the parties seek to utilize a tool with established methodologies and protocols. Use of the CRAM methodology in this context is not meant to characterize the stream habitat as "wetlands" for regulatory purposes. In this document, the term "habitat" will be utilized to describe the features assessed.

The upstream most AAs received the highest overall CRAM score because these monitoring locations are located upstream of existing point source discharges. AAs located downstream of the Upper Discharge Location were similar in overall CRAM scores (numeric values ranging from 73.0 to 77.4) because these areas are influenced by industrial mining operations. The Downstream Discharge Location received the lowest CRAM score of all AAs (45.3), because this section of the creek flows through a concrete-lined trapezoidal channel, which decreases the physical and biotic variability of the channel.

These scores will be useful in establishing a baseline of aquatic resource functions in the Permanente Creek channel and for supporting the Flow Study Plan.

The biotic structure attribute scores are similar for all natural bottom AAs. The vegetation assemblage at MS-US, located upstream of the Upper Discharge Location, is similar to the vegetation encountered at downstream AAs. Native woody shrub and tree species are prevalent below the bankfull channel. The MS-US location remained dry throughout the period of stream flow monitoring (August 2017 through February 2018), further supporting that shrubs and trees are not reliant on surface water flow and therefore not likely to be adversely affected by the relocation of the discharge location.

Pursuant to a negotiated Consent Decree in the case Sierra Club v. Lehigh Southwest Cement Company and Hanson Permanente Cement, Inc., U.S. District Court, Northern District, Case No.: 5:11-cv-06392-HRL, and a Cleanup and Abatement Order issued by the SFRWQCB, Lehigh Hanson proposes to restore portions of the upper Permanente Creek streambed, banks, and floodplain. The stream channel aspect of the Permanente Creek Restoration Project involves removal of overburden from the creek channel, removal of a settling pond dam, and removal of a half-culvert and other culverts to create a wider stream channel. The result of the Permanente Creek Restoration Project will be to improve existing stream hydraulics and streambank/floodplain habitat. The Permanente Creek Restoration Project will extend approximately 3.7 miles and occur mostly between the Upper and Downstream Discharge Locations.

Chapter 1. Introduction

This report presents the results of a habitat condition assessment conducted along Permanente Creek at the Permanente Quarry and Cement Plant (Facility), operated by Lehigh Southwest Cement Company and owned by Hanson Permanente Cement, Inc. (collectively referred to herein as Lehigh Hanson) using the California Rapid Assessment Method (CRAM) for riverine wetlands (CWMW 2013).[1] CRAM is a standardized, cost-effective, and scientifically defensible methodology for rapidly assessing the conditions and trends of water features. This report describes the purpose for conducting this habitat assessment, provides a brief background on CRAM, summarizes study methodology, presents results, and discusses beneficial uses of Permanente Creek as defined by the *San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan)* (SFRWQCB 2007).

1.1 Purpose and Need

The amendment to the NPDES permit and CDO accounts for final design changes made to the Final Treatment System Upper and Lower and final process flow configuration, to ensure adequate water treatment, sufficient area for treatment units, adaptability to changing quarry and cement plant operations and conditions, and efficient flow management. Specifically, these changes include the following:

- Additional ultrafiltration/reverse osmosis treatment trains as part of the final treatment system.
- Expanded authorized locations for discharges from the Final Treatment System Upper and Lower as Discharge Point No. EFF-001.
- Final process flow configuration that includes recently constructed Pond 1 and removes Pond 4A, and sends certain flows previously discharged at Discharge Point Nos. 005 through 006 to the Final Treatment System and Discharge Point No. EFF-001.

Due to the ongoing operational changes and optimization of the Facility, and the future Permanente Creek Restoration Project that will result in restoration activities between the current Upper and Downstream Discharge Locations, Lehigh Hanson seeks to eventually discharge the entirely of the Facility's non-continuous discharges at the Downstream Discharge Location. The NPDES permit amendment authorizes Lehigh Hanson to discharge the entirety of the Facility flows from points downstream of the previously static location of EFF-001 (near the location of the now unused Pond 4A, the Upper Discharge Location); however, until the Permanente Creek Restoration Project is underway, the SFRWQCB requested Lehigh Hanson to study and ensure that beneficial uses of Permanente Creek are protected (with minimum discharge flows, if necessary) should discharge relocation occur during this interim period. For this reason, the NPDES permit amendment added Provision VI.C.7, which requires Lehigh Hanson to conduct a Flow Study Plan and Monitoring according to the following terms:

---

1 While CRAM was developed to assess wetland habitat, rather than stream habitat, many of the same features are relevant to the analysis Lehigh Hanson was requested to undertake via the NPDES Permit amendment, and the parties seek to utilize a tool with established methodologies and protocols. Use of the CRAM methodology in this context is not meant to characterize the stream habitat as "wetlands" for regulatory purposes. In this document, the term "habitat" or "feature" will be utilized to describe the features assessed.

The Discharger shall ensure minimum flows in Permanente Creek adjacent to the Facility as necessary to protect existing aquatic habitat beneficial uses until such reaches are disrupted for habitat restoration in accordance with a restoration plan the Regional Water Board authorizes.

a. By December 1, 2017, the Discharger shall submit a Flow Study Plan to determine the minimum flow necessary to protect existing Permanente Creek aquatic habitat beneficial uses year-round and management measures to sustain such flows.

b. By March 1, 2018, the Discharger shall submit a Flow Study Report reflecting any and all Regional Water Board staff feedback on the Flow Study Plan. The report shall propose actions necessary to ensure minimum flows necessary to protect existing aquatic habitat beneficial uses. At times, these actions may include pumping some, but not necessarily all, effluent from the final treatment system to upstream reaches. The Flow Study Report shall include monitoring actions to demonstrate flows sufficient to protect existing aquatic habitat beneficial uses.

c. By May 1, 2018, the Discharger shall implement the actions set forth in the Flow Study Report as necessary to protect existing aquatic habitat beneficial uses. The Discharger shall also report in the cover letter to its monthly self-monitoring reports its findings from the monitoring actions set forth in the Flow Study Report.

d. If the Flow Study Report proposes discharges at any Permanente Creek location other than the concrete-culverted portion of Permanente Creek near Pond 20, the Discharger shall ensure that such discharges do not cause sedimentation or erosion within Permanente Creek sufficient to cause or contribute to adverse impacts on Permanente Creek beneficial uses.

This report has been prepared in compliance with Provision VI.C.7 of the NPDES permit amendment. CRAM was conducted at seven locations along Permanente Creek: MS-1, MS-US, Upper Discharge Location, RSW-001, RSW-002, RSW-003, and the Downstream Discharge Location (37.31837 N, -122.08712 W) (Appendix B Figure 1). Stream monitoring stations are established at each location where CRAM was conducted, with the exception of the Downstream Discharge Location. This report is intended to document the existing conditions along the Permanente Creek corridor, provide the basis for discussion about the beneficial uses assigned to the creek as defined by the Basin Plan (SFRWQCB 2007), and comply with Provision VI.C.7 of the NPDES permit amendment to conduct a Flow Study Plan.

The objectives for conducting CRAM along Permanente Creek were to:

- Provide a standardized, scientifically based assessment of the habitat conditions of Permanente Creek at each stream monitoring location (including the existing Upper Discharge Location EFF-001), and the Downstream Discharge Location.

- Document the baseline aquatic habitat condition along Permanente Creek and discussion of beneficial uses. Baseline habitat conditions and beneficial use conclusions are supported using the data collected during the CRAM analysis.

- Support permit decisions (*i.e.,* NPDES) by regulatory agencies (SFRWQCB) with the ability to compare the condition of aquatic features, as needed in the future.

1.2 California Rapid Assessment Method

CRAM was developed by the CRAM Core Team members and teams of regional experts. The Core Team consists of 28 technical experts from government agencies, nongovernmental organizations, and academia, including members from U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (USACE), State Water Resources Control Board (SWRCB), the San Francisco Estuary Institute, the California Coastal Commission, regional water quality control boards, Moss Landing Marine Laboratories, and various universities. The regional teams are similarly composed of regional technical experts from each of the following regions: central coast, north coast, San Francisco Bay, and southern California. CRAM is based on the most current scientific literature regarding wetland processes, biological condition, and assessment procedures; the professional experience of the team members; and established conceptual models of wetland form and function.

CRAM was first released (version 3.0) in September 2004 and was most recently updated to version 6.1 in January 2013 (CWMW 2013). The development of CRAM was part of a larger effort to develop new tools to increase the state's capacity to monitor its wetlands and water features. The effort followed a three-tiered approach for surface water monitoring and assessment issued by EPA (EPA 2006). **Level 1** consists of conducting resource inventories and preparing maps that address questions about the general extent and distribution of water resources. **Level 2** consists of conducting rapid, field-based assessments that assess existing conditions relative to the broadest suite of suitable functions and beneficial uses (*e.g.,* flood control, groundwater recharge, pollution control, wildlife habitat) based on the consensus of best professional judgment (*i.e.,* the consensus of technical experts, such as the CRAM Core Team and regional team members). **Level 3** assessments are more intensive studies that provide quantitative data about selected functions and beneficial uses of the water feature. Examples of Level 3 studies include vegetation transects, macroinvertebrate or algae Indices of Biotic Integrity, and rare species surveys.

CRAM scores have been validated by regressing metric and attribute scores from Level 3 CRAM data, which represent the expected relationship between condition and function or service. CRAM scores for each CRAM module undergo extensive Level 3 validation studies. In general, these studies show that habitats with high CRAM scores tend to support larger native plant and wildlife populations or otherwise provide higher ecological functions than habitats with low CRAM scores. A full report of the validation efforts to date is available at the CRAM web site (www.cramwetlands.org).

CRAM assesses conditions and trends by qualitatively rating four main attributes: buffer and landscape context, hydrology, physical structure, and biotic structure. For each of these attributes, metrics and submetrics are assessed to address the specific aspects of the water feature's condition. Although the four attributes are the same for any type of wetland, the metrics are customized for different types of wetlands and were developed based on characteristics of wetlands observed across a range of reference conditions (Smith et al. 1995), such that the highest score for each metric/submetric represents the theoretical optimum condition obtainable for the wetland feature being evaluated in California. In the field, two to three trained practitioners visually assess the conditions and record the score for each metric and submetric on a CRAM worksheet. These scores are then used to calculate the final scores for each attribute and the average or overall score for the area being assessed. The procedure typically requires 1 to 3 hours in the field.

This page intentionally left blank.

Chapter 2. Environmental Setting

The Facility is located in Santa Clara County at 24001 Stevens Creek Boulevard. Approximately 4.2 miles of Permanente Creek traverse land owned and operated by Lehigh Southwest Cement Company and Hanson Permanente Cement Co. The creek is located south of the Facility operations. The study area for this report is defined as the seven AAs completed along Permanente Creek within property operated and owned by Lehigh Hanson. The portions of Permanente Creek evaluated using CRAM are located within Section 13 and 18 of the U.S. Geological Survey (USGS) 7.5-minute Mindego Hill Quadrangle, Township 7 South, Range 3 West and Sections 16, 17, 20, and 21 of USGS 7.5-minute Cupertino Quadrangle, Township 7 South, Range 2 West. Elevations range from approximately 470 feet above mean sea level at the eastern boundary of the study area to 1,870 feet above mean sea level at the western boundary.

The nearest precipitation gauge, operated by Santa Cruz County, is located approximately 7.2 miles south of the Facility. At the time the field survey was conducted on February 1–2, 2018, 13.98 inches of rain had been recorded at the Las Cumbres weather station (DWR 2018). The region typically receives 36.65 inches of precipitation annually (WRCC 2012).

Permanente Creek is located within the Permanente Creek-Frontal San Francisco Bay Estuaries watershed (USGS Hydrologic Unit Code 180500030406), which encompasses approximately 17 square miles (15,550 acres). The creek is approximately 13.1 miles in length, Permanente Creek headwaters are located approximately 0.6 miles west of the western boundary of the Facility; the headwaters are protected by the Midpeninsula Regional Open Space District.

The upper watershed of Permanente Creek is located within the Santa Cruz Mountains, and steep slopes constrain the floodplain through much of the study area. Within the western (upstream) portion, in the vicinity of MS-1, the channel is relatively narrow and the bankfull width of the channel measures approximately 5-6 feet. As the channel flows east, the channel widens to a width of 8 to 12 feet, as a result of ephemeral tributaries contributing flow to Permanente Creek. The channel is relatively unaffected by quarry operations at MS-1 (Appendix B, Figure 1). In the vicinity of MS-US, the creek is affected by rock material (*e.g.*, riprap, concrete debris, etc.), and historical sloughing of slopes within the canyon. At the Upper Discharge Location, the creek is also subject to inputs from discharge flows. Portions of Permanente Creek at or near the Cement Plant have been re-aligned into a straight channel, or placed into underground culverts below RSW-001 (Appendix B, Figure 1).

Permanente Creek has a clear and evident bankfill width (*i.e*, ordinary high-water mark, OHWM). Evidence of scouring, undercutting of banks, water marks, debris deposits, and sediment sorting can be observed throughout the length of the channel. Portions of Permanente Creek were flowing at the time of the February 2018 CRAM assessment field survey. While the MS-1 assessment area (AA) contained flowing water, the flow goes subsurface upstream of MS-US and the channel is dry until treated water is discharged from the Upper Discharge Location. Downstream of that discharge location, there was flowing water at the time of the field survey and treated water was being discharged. Flow data collected from August 2017 through February 2018, which was relatively dry, indicates that in-channel flow at RSW-001 and RSW-002 are largely dependent on discharge at the Upper Discharge Location. Sustained base flow of approximately 0.1 cubic feet per second (cfs) was documented at RSW-003 independent of discharge at the Upper Discharge Location (Lehigh Hanson 2018).

In terms of the Facility discharge from the Upper Discharge Location, the daily discharge rate from the can be variable and non-continuous throughout the day. In addition to daily variability, it is common for no discharges to occur for extended periods depending on site operations and precipitation rates (discharges are largely rainfall dependent). For example, as part of Lehigh Hanson's goal to conserve water, excess quarry water is used when possible during the dry seasons as make-up water for the Cement Plant Reclaim Water System. As such, Permanente Creek in these reaches already experiences sustained periods of time where only base flow provides whatever volume may be present in the creek.

Tree and shrub vegetation is well-established throughout the length of Permanente Creek. Dominant trees include Goodding's willow (*Salix gooddingii*), white alder (*Alnus rhombifolia*), big leaf maple (*Acer macrophyllum*), California Bay (*Umbellularia californica*), and madrone (*Arbutus menziesii*). Shrubs including arroyo willow (*Salix lasiolepis*), shining willow (*Salix lucida* ssp. *lasiandra*), western creek dogwood (*Cornus sericea* ssp. *occidentalis*), and California buckeye (*Aesculus californica*) (NL) are prevalent along the channel banks and are well established and mature below the OHWM in the AAs that encompass the MS-US, Upper Discharge Location, and RSW-002 stream monitoring locations. Stinging nettle (*Urtica dioica*) and poison oak (*Toxicodendron diversilobum*) are abundant along the creek channel.

Chapter 3. Methods

The objectives outlined in Section 1.0, Introduction, were guided by the NPDES Permit Amendment (Order No. R2-2017-0030) requiring Lehigh Hanson produce a Flow Study Plan. The assessment areas (AAs) were selected based on the presence of existing stream monitoring locations and the location of the Proposed Discharge Location.

The CRAM assessment was conducted by Sarah A. Norris and Devin Barry of GEI Consultants, Inc. (GEI). The existing conditions of riverine habitat on the site were assessed using the methods described in *California Rapid Assessment Methods (CRAM) for Wetlands User's Manual Version 5.0.2* (CWMW 2008). Data were collected based on the updated riverine module released in 2013 (CWMW 2013). This procedure consists of the following seven general steps, which are described below:

1. Assemble background information.
2. Classify the feature according to the CRAM manual.
3. Verify the appropriate assessment season.
4. Estimate the AA boundary, and verify it in the field.
5. Conduct the office assessment of stressors and conditions of the AA.
6. Conduct the field assessment of stressors and conditions of the AA.
7. Complete CRAM assessment scores and quality assurance/quality control procedures.

3.1 Step 1: Assemble Background Information

Background information, including aerial photography of Permanente Creek, the *Preliminary Delineation of Waters of the United States, Including Wetlands for the Lehigh Hanson Permanente Creek Project* (Lehigh Hanson 2015), the Basin Plan, and NPDES permit documents, were reviewed before the field assessment was conducted (see Step 6 below).

3.2 Step 2: Classify the Habitat

CRAM follows the Cowardin et al. (1979) classification system for wetlands. It also further defines a wetland as the vegetated portion of a discrete area of wetland habitat that is large enough to contain one or more CRAM AAs.

The CRAM manual provides a flow chart for determining the wetland type and subtype. Riverine AAs along Permanente Creek include confined and non-confined stream habitat.

3.3 Step 3: Verify the Appropriate Assessment Season

The appropriate assessment season is the period each year when assessments of the habitat's condition based on CRAM should be conducted. In general, the CRAM assessment season falls within the growing season for the characteristic plant community of the feature type to be assessed. This period can vary each year depending on weather conditions. The CRAM survey was conducted on February 1–2, 2018, to ensure compliance with the SFRWQCB requirement that the Flow Study Plan be submitted by March 1, 2018.

3.4 Step 4: Establish the Assessment Area Boundary

The AA is the portion of the habitat that is assessed using CRAM. Each AA must not encompass or involve more than one feature or more than one type of feature. Each AA must encompass most, if not all, of the natural spatial variability in the visible form and structure of the feature and most of the internal workings that account for its homeostasis (*i.e*., its tendency to maintain a certain overall condition or return to it during or after significant stress or disturbance). To achieve this desired level of integrity, the AA should not extend beyond any features that represent or cause a major spatial change in water source or sediment source. There are also preferred and minimum size guidelines for AAs of each feature type.

The AAs are first delineated in the office using the background information gathered in the first step and then verified in the field before the assessment. The AAs were established at existing stream monitoring locations, including the Upper Discharge Location. The Downstream Discharge Location presently lacks a stream monitoring station, but was assessed using CRAM since this location would be the future primary discharge location for treated water.

3.5 Step 5: Conduct the Office Assessment

For all AAs identified during Step 4, metrics assessed initially in the office included aquatic area abundance, percent of AA with buffer, average buffer width, water source, and hydrologic connectivity. (See description of metrics below under Section 3.6, Step 6: Conduct the Field Assessment.) Possible stressors initially identified included point source discharges, flow obstructions (*i.e*., culverts), excessive sediment from the watershed as a result of steep slopes, and physical resource extraction associated with industrial processes (i.e., mining). These initial assessments were subsequently verified during the field assessment.

3.6 Step 6: Conduct the Field Assessment

Following CRAM procedures, four attributes were evaluated in each AA. These attributes are buffer and landscape context, hydrology, physical structure, and biotic structure. Each attribute is scored based on a specific set of condition metrics and submetrics. Each metric is assigned an alphanumeric score of A, B, C, or D where A = 12 points, B = 9 points, C = 6 points, and D = 3 points, and these points are used to calculate the attribute score. As stated above, an A represents the theoretical optimum condition for that habitat type in California, whereas a D represents the lowest possible condition that a habitat can provide. It is important to note that even a highly degraded feature will still receive a condition score because CRAM considers the existence of a water feature to be of value. Each attribute has a minimum and maximum achievable score. The calculation of the raw score varies by attribute and is calculated using either a simple algorithm or by obtaining the sum of the submetrics and dividing it by the maximum achievable score to obtain a percent of the maximum possible score for each attribute. The overall AA score is an average of the four final attribute scores. Table 3-1 provides a quick reference to the attributes and their metrics and submetrics.

Table 3-1. CRAM Attributes and Metrics

Attributes	Metrics/Submetrics
Buffer and landscape context	Aquatic area abundance (previously landscape connectivity)
	Buffer submetrics:
	Percent of AA with buffer
	Average buffer width
	Buffer condition
Hydrology	Water source
	Hydroperiod or channel stability
	Hydrologic connectivity
Physical structure	Structural patch richness
	Topographic complexity
Biotic structure	Plant community submetrics:
	Number of plant layers present or native species richness (vernal pools only)
	Number of codominant species
	Percent invasion
	Horizontal interspersion and zonation
	Vertical biotic structure

Source: Adapted from CWMW (2013)

3.6.1 Buffer and Landscape Context

For the purposes of CRAM, a buffer is a zone of transition between the immediate margins of a feature and its surrounding environment that is likely to help protect from anthropogenic stress (*e.g.*, pollutants, disruptive incursions by people, nonnative predators, invasive plants and animals). The metrics included in the buffer and landscape context attribute are designed to measure the ability of the surrounding landscape to buffer the feature from these stresses.

3.6.2 Hydrology

The hydrology attribute includes the sources, quantities, and movements of water, along with the quantities, transport, and fate of waterborne materials, particularly sediment as bed load and suspended load. The physical structure of a wetland (similar to a stream) is largely determined by the magnitude, duration, and intensity of water movement. Hydrology also affects many physical processes and contributes to creation of a dynamic habitat. The metrics included in the hydrology attribute are typically used to assess the source of water in a wetland during the dry season, the typical frequency and duration of inundation or saturation of a wetland, and the ability of water to flow into or out of a wetland.

The hydrologic connectivity metric score is assigned based on the entrenchment ratio, which is calculated by dividing the flood-prone width (defined as at least twice the bankfull width) by the bankfull width. The lower the entrenchment ratio is, the greater the degree of channel entrenchment. The entrenchment ratio was measured or estimated at three replicate cross sections, where access allowed, and then averaged to obtain an average entrenchment ratio for the AA.

3.6.3 Physical Structure

Physical structure is defined as the spatial organization of living and nonliving surfaces that provide habitat for biota. Metrics of the physical structure attribute therefore focus on physical conditions that are indicative of the capacity of a feature to support characteristic flora and fauna (i.e., the diversity and complexity of physical structure in a feature).

3.6.4 Biotic Structure

The biotic structure of a feature includes all the organic matter that contributes to its material structure and architecture. Plants strongly influence the quantity, quality, and spatial distribution of water and sediment in a water feature and provide habitat for wildlife. The biotic structure metrics measure the diversity and native status of plant species, as well as the structural complexity of plant types and associations. See Chapter 4 in *California Rapid Assessment Method (CRAM) for Wetlands and Riparian Areas*, Version 6.1 (CWMW 203), for a more detailed description of the attributes and guidelines for scoring the metrics.

After each metric for a given AA was assessed, a stressor checklist worksheet was completed in the field by biologists. The stressor checklist provides a list of activities that could negatively influence the metric scores for each attribute assessed under CRAM. Examples include point-source discharges, flow diversions, upstream presence of dams or weirs, grading, causing excessive sediment, mowing, and proximity to industrial, commercial, agricultural, or residential land uses. The stressor checklist worksheets are provided in the data sheets found in Appendix A of this report.

3.7 Step 7: Complete CRAM Assessment Scores

As described in detail in the Section 4, Results, CRAM assessment scores were calculated.

Chapter 4. Results

4.1 Buffer and Landscape Context Attribute

The aquatic area abundance metric for riverine systems is used to assess the continuity of the riparian corridor over a distance of approximately 500 meters upstream and 500 meters downstream of the AA. The upstream most AAs (MS-1, MS-US, Upper Discharge Location) received score of “A’ for this metric. The AAs located below the RSW-001 stream monitoring location typically encounter culverts, reducing the amount of stream continuity that is present up and downstream of the AA. All AAs below RSW-001 received scores of “B” because an up or downstream segment had a non-buffer segment between 100–200 meters and the opposite up or downstream segment had a non-buffer segment of less than 100 meters (Appendix B).

The buffer metric is composed of three submetrics used to assess various elements of the buffer habitat, including width and condition. The scoring for these submetrics is combined with the aquatic area abundance metric score in a simple algorithm that results in the overall score for the buffer and landscape context attribute.

The percentage of buffer surrounding an AA is obtained by calculating the percentage of the area adjoining the AA that is in a natural or seminatural state and is at least 5 meters wide. All AAs are surrounded by a buffer along the entire length on along the southern slope and therefore received a score of “B” for this submetric. The MS-1 location has buffer on both sides of the AA, is located above the influence of the Quarry and Cement Plant, and therefore received a score of “A”.

The average width of contiguous buffer adjoining each AA is estimated, with a maximum width of 250 meters. This submetric is assessed using eight lines extending parallel from the AA boundary (Appendix B). The lines are placed in the area already determined to be buffer habitat and are extended from the AA boundary until they reach a nonbuffer area (*e.g.*, industrial development, roads) or until they reach the maximum evaluation length of 250 meters. The average buffer width varied at each AA based on proximity to industrial land use, which is consistently present along the north slope of the AAs, but at varying distances.

The condition of the buffer area is determined by the quality of its vegetation cover (native versus nonnative species), the overall condition of its substrate (disturbed or undisturbed soils), and intensity of human use. All AAs below MS-1 scored a “C” because of the proximity of industrial land use. Erosion control is present along the north slope in the vicinity of MS-US and the Upper Discharge Location.

Table 4-1. CRAM Scores for Riverine Assessment Areas

CRAM Attributes	CRAM Metric and Submetric	MS-1	MS-US	Upper Discharge Location	RSW-001	RSW-002	RSW-003	Downstream Discharge Location
Buffer and landscape context	Raw attribute score	24/24	19/24	19/24	16/24	15.6/24	14.5/24	16.3/24
	Final attribute score	100	79.2	79.2	66.7	65	60.4	67.9
	Stream Corridor Continuity	12 (A)	12 (A)	12 (A)	9 (B)	9 (B)	9 (B)	9 (B)
	Percentage of AA with buffer	12 (A)	9 (B)	9 (B)	9 (B)	9 (B)	9 (B)	9 (B)
	Average buffer width	12 (A)	9 (B)	9 (B)	9 (B)	6 (C)	3 (D)	9 (B)
	Buffer condition	12 (A)	6 (C)	6 (C)	6 (C)	6 (C)	6 (C)	6 (C)
Hydrology	Raw attribute score	36/36	33/36	27/36	24/36	27/36	27/36	12/33
	Final attribute score	100	91.6	75	66.7	75	75	33
	Water source	12 (A)	12 (A)	6 (C)	6 (C)	6 (C)	6 (C)	6 (C)
	Channel stability	12 (A)	9 (B)	9 (B)	9 (B)	9 (B)	9 (B)	3 (D)
	Hydrologic connectivity	12 (A)	12 (A)	12 (A)	9 (B)	12 (A)	12 (A)	3 (D)
Physical structure	Raw attribute score	21/24	21/24	18/24	18/24	21/24	21/24	6/24
	Final attribute score	87.5	87.5	75	75	87.5	87.5	25
	Structural patch richness	12 (A)	9 (B)	9 (B)	9 (B)	12 (A)	12 (A)	3 (D)
	Topographic complexity	9 (B)	12 (A)	9 (B)	9 (B)	9 (B)	9 (B)	3 (D)
Biotic structure	Raw attribute score	30/36	28/36	29/36	29/36	26/36	25/36	20/36
	Final attribute score	83.3	82.3	80.5	80.5	72.2	69.4	55.6
	Plant community: number of plant layers	12 (A)	12 (A)	12 (A)	12 (A)	9 (B)	9 (B)	9 (B)
	Plant community: number of codominants	12 (A)	6 (C)	9 (B)	12 (A)	12 (A)	9 (B)	3 (D)
	Plant community: percent invasion	12 (A)	12 (A)	12 (A)	9 (B)	12 (A)	12 (A)	12 (A)
	Plant community submetric score	12	10	11	11	11	10	8
	Horizontal interspersion and zonation	9 (B)	9 (B)	9 (B)	9 (B)	6 (C)	6 (C)	3 (D)
	Vertical biotic structure	9 (B)	9 (B)	9 (B)	9 (B)	9 (B)	9 (B)	9 (B)
Total AA score		111/120	101/120	93/120	87/120	89.6/120	87.5/120	54.3
Overall AA score		92.7	85.2	77.4	72.2	74.9	73.0	45.3

Source: From data collected by GEI Consultants, Inc.

4.2 Hydrology Attribute

Water sources directly affect the extent, duration, and frequency of saturated or ponded conditions in an AA. The hydrology attribute is assessed based on water sources that affect the dry season and addresses both additional artificial inputs (point source discharges, runoff) and restrictions (dams, weirs, and drop structures). The water source for MS-1 and MS-US are located upstream of the Upper Discharge Location and therefore received the highest possible score. The AAs located below the Upper Discharge Location received a "C" rating because point source discharges alter the natural hydrology of these reaches of Permanente Creek. Further, the point source discharge from the Upper Discharge Location is non-continuous and variable, and largely weather-dependent.

As described in the CRAM Riverine Field Manual, channel stability is assessed as the degree of channel aggradation (*i.e.*, net accumulation of sediment on the channel bed causing it to rise over time) or degradation (*i.e*., net loss of sediment from the bed causing it to lower over time) (CWMW 2013). Various field indicators were recorded to aid in determining whether each AA is in a state of equilibrium, aggradation, or degradation, but ultimately the CRAM practitioners use the field observations and their understanding of what would be expected for this system type to generate a score. MS-1 was assigned an "A" rating since the channel displays evidence of equilibrium, with some indication of aggradation and degradation. The Downstream Discharge Location AA received a score of "D" since this AA is located in a concrete-lined portion of the Permanente Creek. The remainder of the AAs received "B" scores because the channel shows signs of both aggradation and degradation. The most common indicators of aggradation observed through the channel that parallels the active quarry and cement plant include mature vegetation rooted below the bankfull channel and partially buried/sediment choked culverts.

Hydrologic connectivity refers to the ability of water in the channel to flow into or out of the feature or to inundate adjacent uplands. This is assessed by calculating the entrenchment ratio, which is the flood-prone width divided by the bankfull width. The larger the ratio, the less entrenched the channel is and the more likely an average rain event will top the banks and flood the adjacent habitat. All AAs received a score of "A" or "B" with entrenchment ratios of 1.8 to 2.0, with the exception of the Downstream Discharge Location. The Downstream Discharge Location received a scope of "D" because this portion of the creek is concrete-lined.

4.3 Physical Structure Attribute

Patch richness refers to the number of different types of physical surfaces or features (*i.e*., patch types) that may provide habitat for aquatic, wetland, or riparian species. A non-confined riverine system has the potential to support up to 17 patch types in the context of CRAM, although what is possible for any given system may be different. Each AA (except the Downstream Discharge Location, which received a score of "D") received a physical structure attribute score of "A" or "B" because a diversity of patch types were observed in each of the AAs. Patch types common throughout the Permanente Creek corridor include bank slumps in the lower reaches of the stream and undercut banks in the upper portion of the corridor, cobbles, large woody debris, shallow pools on the floodplain, and variegated foreshore.

Topographic complexity refers to the variety of elevations in a wetland attributable to physical, abiotic features and elevation gradients. This metric is used to provide an overall assessment of macrotopographic (floodplain benches) and microtopographic (patch types) features. The metric addresses two main components of complexity: large-scale complexity in the form of larger benches and small-scale complexity, such as microtopography. AAs assessed generally scored a B because one break in slope is evident and microtopography is abundant. The MS-US AA received a score of A because 2 benches were evident and microtopography is abundant. The Downstream Discharge Location received a scope of “D” because the channel is concrete lined and trapezoidal.

4.4 Biotic Structure Attribute

The biotic structure attribute is composed of three metrics, one of which (plant community) is further divided into three submetrics. The scoring for these submetrics is averaged for an overall metric score that is combined with the other biotic structure metric scores to obtain an overall attribute score.

To be counted in CRAM, a layer must cover at least 5% of the portion of the AA that is suitable for the layer. For a definition of each layer type, refer to Table 17 of the *California Rapid Assessment Method for Wetlands*, Riverine Wetlands Field Book (CWMW 2013). The three downstream most AAs (RSW-002, RSW-003, and Downstream Discharge Location) had at least three plant layers well represented throughout the length of the AA, obtaining a score of B for this submetric. The upstream AAs (MS-1, MS-US, Upper Discharge Location, RSW-001) had at least four plant layers and therefore received a score of “A”.

For each plant layer present in the AA, all living species represented that compose at least 10% relative cover in each layer are considered dominant species. Although species may and often do occur as dominant species in multiple layers, an individual species is counted only once for the total number of codominants. (*See* Plant Community Metric Worksheet in Appendix A for additional detail.) There is generally a high degree of vegetative diversity present within the Permanente Creek corridor and therefore all AAs had at least eight codominant species. The Downstream Discharge Location received the lowest score of all AAs for this submetric. Since the channel is concrete lined, there is less substrate to support vegetative growth and therefore fewer codominant species.

The number of invasive or nonnative codominant species for all plant layers combined is assessed as a percentage of the total number of codominants in the AA. The percent invasion is very low along the AAs within the study area. All AAs have very low colonization, less than 25 percent of the codominant species are considered invasive according to CAL-IPC

The horizontal interspersion and zonation metric is a measure of horizontal biotic structure, which refers to the variety and interspersion of plant “zones.” Plant zones are often plant monocultures or obvious multispecies associations that are arrayed along gradients of elevation, moisture, or other environmental factors. Interspersion is essentially a measure of the number of distinct plant zones and the amount of edge between them. The upstream most AAs (MS-1, MS-US, Upper Discharge Location, RSW-001) had the most horizontal interspersion and received scores of “B”. RSW-002 and RSW-003 had less horizontal interspersion and received scores of “C”. Horizontal interspersion is very low at the Downstream Discharge Location and this AA received a score of “D”.

The vertical biotic structure metric is used to assess the vertical component of a biotic structure, which consists of the interspersion and complexity of the plant layers previously used in the plant community submetrics discussed above. This metric is used to quantify the amount of overlap among the layers, with a higher score resulting from overlap of multiple layers and high-percent coverage in the AA. Although at least three plant layers were recorded for each AA, the amount of overlap was similar among all AAs. All AAs received a score of “B”.

4.5 Discussion of Riverine Stressors

Stressors are not quantitatively measured in the CRAM assessment, but rather a checklist is completed noting the presence of stressors within or adjacent to the AA. Hydrologic modification is the greatest stressor on Permanente Creek. Point source discharges occur along Permanente Creek at the Upper Discharge Location and several points downstream of this location. Flow obstructions such as the weir that impounds instream Pond 13 and the culverts located downstream of RSW-001 also disrupt the normal hydrologic stream processes. Sedimentation is a physical stressor that is notable in the vicinity of the Upper Discharge Location and MS-US. These AAs are located between two steep slopes. The industrial mining occurring along the left bank of Permanente Creek has resulted in non-native slopes. Erosion control has been erected in the vicinity of MS-US and RSW-001 to limit sediment entering the creek. All AAs have industrial stressors associated with resource extraction (i.e., mining) within 500 meters of the AA.

This page intentionally left blank.

Chapter 5. Creek Functions and Values

As previously indicated, CRAM is used to assess wetland condition, which can be used to indicate potential wetland function. Wetland functions are defined as processes or services that take place in a wetland. These functions fall into three broad categories: habitat, hydrologic, and water quality. Habitat functions are those services that benefit wildlife and include provision of food, shelter, water, and breeding grounds. Hydrologic functions include groundwater recharge and discharge, water storage, and reduction in flow velocity. Water quality functions include sediment trapping and nutrient removal and transformation. Although wetland functions generally fall into these three broad groups, many functions are interdependent; if one function is impaired, it can affect other wetland functions. CRAM is designed to measure the ability of a particular feature to provide ecological functions. The higher the CRAM score, the better the functional condition of the feature. [2] For this analysis, we use CRAM similarly to assess the condition of Permanente Creek.

The MS-1 AA received the highest overall CRAM score (92.7), due to the high scores received for both the buffer and landscape context and hydrology metrics. CRAM scores generally decreased at downstream AAs, largely due to lower scores received for buffer and landscape context and hydrology metrics. Specifically, the stream continuity score decreased below RSW-001 as a result of culverted sections of Permanente Creek, lack of buffer width along the right bank of the stream, and altered hydrology due to the presence of upstream point source discharges. The Downstream Discharge Location received the lowest overall CRAM score (45.3) because this section of the channel is concrete-line and trapezoidal, which limits the physical and biotic metric scores of this AA.

All the AAs assessed, except MS-1, received moderate buffer and landscape context attribute scores (numeric scores ranging from 79.2 to 60.4). Moderate to low buffer condition scores were received because of the proximity of non-buffer areas (*i.e.*, active mine roads and industrial resource extraction). MS-1 received the highest buffer and landscape score (100) because this AA is located high in the watershed where influences of the active quarry and cement plant exceed 250 meters from the AA.

The upper portions of Permanente Creek scored high for the water source metric, but the score decreased and was a consistent "C" below the Upper Discharge Location due to the input of point source discharges. The AAs conducted on the natural bottom stream of Permanente Creek have entrenchment ratios ranging from 1.9 to greater than 2.2, indicating little to no channel entrenchment and that the floodwaters still have access to the floodplain, and resulting in high scores for the hydrologic connectivity metric. The Downstream Discharge Location scored the lowest (33) on the hydrology attribute. AAs located below the Upper Discharge Location typically scored 75 on the hydrology attribute.

---

2 Values are the benefits that wetland functions provide; they can be ecological, social, or economic. Wetland values can be difficult to measure because the value of a particular wetland function can vary considerably depending on the person making the evaluation. CRAM cannot be used to assign a value to a wetland; it can be used only to assess the condition of the wetland. Because CRAM provides a means to measure wetland condition, the CRAM scores can, theoretically, be used by the SFRWQCB to help determine the value of a given wetland based on its potential to perform wetland functions and ensure beneficial uses assigned are not adversely affected.

All AAs, with the exception of the Downstream Discharge Location, had a moderately high score for the physical structure attribute because at least one bench with a high degree of microtopography is present throughout the length of the AA, as reported for the topographic complexity submetric. Structural patch richness, the second submetric under the physical structure attribute, received scores of “A” and “B” for the natural bottom AAs because a high number of patch types were represented throughout the length of the AA. Numerous patch types indicate elevation differences throughout the stream, which promotes variable hydroperiods and moisture gradients, which in turn fosters ecological complexity.

All natural bottom AAs had a high degree of codominant species well represented along the length of the AA. At least three plant layers were well represented throughout every AA. The percent invasion is very low along Permanente Creek and therefore, scores were high for the percent invasion submetric. Horizontal interspersion decreases along Permanente Creek, but vertical biotic structure was consistent through the channel with a moderate overlap of vegetation present in all AAs.

A well-functioning riverine environment should have an intermingled patchwork of many native species of trees, shrubs, vines, and herbs. This type of biotic structure provides a varied assemblage of microhabitats for many species of wildlife. The riparian vegetation along Permanente Creek is characterized by a high number of codominant species, which results in several plant layers and relatively high habitat function overall. Woody riparian vegetation also helps diminish the energy of flood flows and filters more nutrients and pollutants from the water column, and contributes to the structural patch richness of the stream.

Chapter 6. Beneficial Uses

The Basin Plan identifies the following seven beneficial uses for Permanente Creek:

- Cold Freshwater Habitat (COLD) − Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

- Ground Water Recharge (GWR) − Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting saltwater intrusion into freshwater aquifers.

- Rare, Threatened, or Endangered Species (RARE) − Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.

- Water Contact Recreation (REC-1) − Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

- Non-Contact Water Recreation (REC-2) − Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

- Spawning, Reproduction, and/or Early Development (SPWN) − Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

- Wildlife Habitat (WILD) − Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

The COLD beneficial use of Permanente Creek is not anticipated to change with the relocation of the discharge flows from the Upper Discharge Location to the Downstream Discharge Location. Lehigh Hanson is required to monitor temperature at the point of discharge.

The GWR beneficial use of Permanente Creek is not anticipated to change with the relocation of the discharge flows from the Upper Discharge Location to the Downstream Discharge Location. Similar flow volumes will be discharged to Permanente Creek and therefore, the overall infiltration and groundwater recharge potential would not be altered. While the channel of Permanente Creek is concrete lined at the Downstream Discharge Location, downstream the channel bottom is natural bottom and infiltration can still occur. No channel hardening is proposed as part of this project. Further, discharge of stormwater is permitted to continue from Discharge Point 002 via Pond 13B, where the channel bottom is natural.

The RARE beneficial use of Permanente Creek is not anticipated to change along the approximately 13 miles of the Permanente Creek stream corridor. The only special-status species known to occur within the study area is California red-legged frog (*Rana aurora draytonii*), which is federally-listed as threatened and a State of California species of special concern. California red-legged frog (CRLF) has been documented in Pond 9, Pond 14, Pond 21, Pond 22, and Pond 30 during incidental observations, habitat assessments, focused aquatic surveys, and/or protocol-level surveys conducted from 1997 to 2014 (WRA 2011, 2014 and Jennings 2006, 2007). Breeding has been documented in Ponds 14 and 21. Ponds 9, 14, and 30 are located off-channel and would not be affected by a change in the discharge location. Ponds 21 and 22 are located off channel or downstream of the Downstream Discharge Location and would not be affected by the change in discharge location, because a similar volume of water would be discharged from the new location.

Currently, within the study area, the creek and riparian corridor provides suitable dispersal and upland habitat for CRLF. The dense overstory trees and shrubs provide adequate cover and undercut banks in isolated locations of the upper study area provide shelter for the species (Bulger et al. 2003, Fellers and Kleeman 2007). The current hydroperiod of Permanente Creek suggests that natural flow within the channel is highly variable. Natural flow is intermittent downstream of MS-1 and upstream of RSW-003, with perennial base flows of approximately 0.1 cfs (40 gallons per minute [gpm]) returning to the channel in the vicinity of RSW-003 (Lehigh Hanson 2018). In some years, such as 2017, discharge to the channel provides supplemental flow throughout the year, including months when this portion of the channel would otherwise be dry. The change in discharge location from the Upper Discharge Location to the Downstream Discharge Location would reduce the overall amount of flow in the affected portion of the channel and would confirm no point source related in-channel flow during the summer months between the Upper Discharge Location and RSW-003 during below average water years, based on the data gathered from the stream monitoring stations (Lehigh Hanson 2018). Stream monitoring data suggests that the primary source of flow at RSW-001 and RSW-002 during the dry season can be the Upper Discharge Location, when that location is discharging. CRLF would still be able to use the Permanente Creek channel as non-breeding aquatic habitat when flows are present and as an upland dispersal corridor when flows are absent.

Suitable breeding habitat for CRLF is typically emergent herbaceous vegetation, such as cattail or tule, in permanent and semi-permanent aquatic features. CRLF typically lay their eggs in clusters around aquatic vegetation from December to early April. Eggs hatch within 2 weeks and undergo metamorphosis 4 to 7 months later (Jennings and Hayes 1990). In-channel emergent vegetation is absent from Permanente Creek within the study area; therefore, relocating the discharge point is not anticipated to affect the vegetative character of the creek. Except for Pond 13, in-channel and floodplain pools between the Upper and Downstream Discharge Locations do not support emergent vegetation and do not remain inundated long enough for CRLF to hatch and complete metamorphosis.

Pond 13 is an in-channel pond within the study area (located approximately 50 feet downstream of RSW-001) that provides potentially suitable breeding aquatic habitat for CRLF; however, the species has not been observed at this pond. Pond 13 supports small areas of cattails, although common horsetail (*Equisetum arvense*) is the dominant emergent vegetation. Herbaceous vegetation at Pond 13 may be affected by moving the Upper Discharge Location, because base flows are likely absent from this section of the channel (based on limited stream hydrograph data collected by Golder Associates), and direct precipitation and surface runoff would be the primary water source (Lehigh Hanson 2018). Pond 13 has steep side slopes and a maximum depth of 5 feet, because a weir is located at the downstream end. It is anticipated that in normal precipitation years, the volume of runoff entering the pond from the surrounding hillslopes and upgradient areas would sustain perennial aquatic habitat. The ponding depth would likely vary, based on seasonal precipitation inputs in the absence of discharge from the Upper Discharge Location, but Pond 13 is anticipated to continue to provide perennial aquatic habitat potentially suitable for breeding. Therefore, the change in discharge location is not anticipated to result in loss of potentially suitable CRLF breeding habitat and would not affect occupied breeding habitat.

In 1940, a California Department of Fish and Game stream survey noted a resident's account of Permanente Creek as formerly a "fine trout stream" from which large trout were captured (Leidy 2007). These were likely the anadromous Central California Coastal steelhead (*Oncorhynchus mykiss*). Since the construction of the Permanente Creek Diversion at the confluence with Stevens Creek, the watershed has been inaccessible to anadromous salmonids and is not designated by National Marine Fisheries Service as critical habitat. The Permanente Creek Diversion is an impassable 10-foot vertical barrier located at the confluence with Stevens Creek. It was reported in 2005 and again in 2007 that all forms (resident and/or anadromous) had been extirpated from Permanente Creek (Leidy et. al., 2005 and Leidy 2007). However, in 2008, approximately 20 *O. mykiss* were captured in a perennial section of Permanente Creek near the Interstate 280 crossing (Garza and Pearse 2008). Genetic analysis showed that these fish were not of hatchery origin and had some level of historic genetic integrity (Garza and Pearse 2008). Upstream of this location, there are currently multiple passage constraints in the form of vertical drops, velocity, and behavioral barriers that prevent their movement upstream and into the headwaters. In December 2017, a GEI fisheries biologist conducted a preliminary habitat assessment and visual observation fisheries survey of Permanente Creek within the quarry. No fish were observed during this survey, little to no available spawning habitat was documented within Permanente Creek that flows through property owned by the Facility. The substrate within the creek below the Upper Discharge Location was noted to be highly embedded and compacted to the point where the substrate was nearly cemented in place. Additionally, the majority of substrate found to be within the size range for resident *O. mykiss* spawning was angular, which is generally considered to be unsuitable for spawning.

The REC-1 and REC-2 beneficial use of Permanente Creek is not anticipated to change with the relocation of the discharge flows from the Upper Discharge Location to the Downstream Discharge Location. Public access is not allowed within the boundaries of the quarry and cement plant, or any portion of the Permanente Creek that flows through the property owned by Lehigh Hanson.

The SPWN beneficial use of Permanente Creek is not anticipated to change along the approximately 13 miles of the Permanente Creek stream corridor. The relocation of the discharge flows from the Upper Discharge Location to the Downstream Discharge Location would result in hydrology that more closely resembles natural conditions (i.e., absence of point-source discharges) upstream of RSW-001. As described in RARE above, *O. mykiss* is presumed to have been extirpated within the headwaters, including the portion of Permanente Creek that flows through property owned by the Facility. It is anticipated that similar flow volumes would be discharged to Permanente Creek at the Downstream Discharge Location as what are currently discharged at the Upper Discharge Location, and therefore, existing fisheries habitat located downstream of the Facility would not be altered.

The WILD beneficial use of Permanente Creek is not anticipated to change with the relocation of the discharge flows from the Upper Discharge Location to the Downstream Discharge Location. The flows within Permanente Creek are variable between MS-US (located upstream of the Upper Discharge Location) and RSW-003, the nearest stream monitoring location to the Downstream Discharge Location, based on the review of the stream monitoring data collected by Golder and Associates (George Wegmann, Golder Associates, personal communication). The MS-US location remained dry throughout the period of stream data collection between August 2017 and February 2018. Flow measured at RSW-001 and RSW-002 had a variable response, with the channel being dry during periods of no discharge. During periods of discharge, flows of 2–3 cfs were documented at RSW-001, and downstream at RSW-002, the in-channel flow was 0.1–0.2 cfs. The reason for decreased flows between RSW-001 and RSW-002 is not fully understood based on the limited monitoring period (Lehigh Hanson 2018).

The vegetation within the channel and riparian corridor is dominated by trees and willow species, which tend to be deeply rooted and do not require surface flows for survival. There is similar vegetation composition and age structure in-channel between stream monitoring locations MS-US (which was dry for the duration of the stream monitoring period) and RSW-003, where base flows are estimated to be 0.1 cfs (Lehigh Hanson 2018). With the exception of the in-channel pond (Pond 13), in-channel herbaceous vegetation is absent throughout the length of the channel. Therefore, the vegetation architecture and plant community composition are not anticipated to change because the same suite of species are present within the creek above the Upper Discharge Location where base flow and in-channel flow post-precipitation events was not recorded during the stream flow monitoring period (Lehigh Hanson 2018). Vegetation structure and composition is not anticipated to change and therefore the WILD beneficial use would not be adversely affected for common wildlife species such as passerine birds. Further, there is no anticipated change in the anticipated flow or in-channel habitat downstream of the Downstream Discharge Location and therefore the WILD beneficial use would not be degraded.

Chapter 7. Recommendations

Permit Provision VI.C.7 (Order R2-2017-0031) requires Lehigh Hanson to submit a Flow Study Plan to the SFRWQCB to "…determine the minimum flow necessary to protect existing Permanent Creek aquatic habitat beneficial uses year-round and management measures to sustain such flows." The Flow Study Plan shall "include monitoring actions to demonstrate that flows are sufficient to protect existing aquatic habitat beneficial uses."

The seven listed beneficial uses are not anticipated to be adversely affected by the change in the primary discharge location from the Upper Discharge Location near Pond 4A to the Downstream Discharge Location. The aquatic habitat beneficial uses for Permanente Creek are primarily RARE and WILD.

Streams are dynamic systems that are constantly responding to natural and/or anthropogenic stresses. Natural hydraulic processes including bank erosion, channel deepening, and sediment deposition can affect the vegetative character by scouring, uprooting trees, depositing sediment, and distributing seeds. The magnitude of natural hydraulic processes is dependent on variables including the intensity and frequency of precipitation events. Point source discharges represent a modification of the natural stream hydrograph. The Upper Discharge Location discharges on a non-continuous basis, based on operations and precipitation. During below average water years and during summer months, baseflow is generally absent from Permanente Creek in the vicinity of MS-US. Moving the non-continuous point source discharge location would restore a more natural hydrograph to the sections of the creek downstream of the Upper Discharge Location.

The vegetative character of Permanente Creek is not anticipated to change between the Upper Discharge Location and the Downstream Discharge Location because the channel is dominated by woody shrub and tree species that tend to be deeply rooted and do not require surface water for survival. The vegetation at MS-US, a section of creek that lacked flow during the stream flow monitoring period, was as robust as the vegetation at RSW-002, a stream section that was generally dry except for a brief period in December 2017 when flows of 0.1 cfs were documented. The woody vegetation was beginning to break bud at the time of the field survey, which was completed in a low water-year, indicative of a more natural flow scenario. At this time, based on existing stream monitoring data, and the habitat assessment contained herein, we conclude that the non-continuous discharge can be fully relocated to the Downstream Discharge Location without the need for minimum flows during the brief period before creek restoration activities are commenced post regulatory agency approval.

This page intentionally left blank.

Chapter 8. References

Bulger, J. B., N. J. Scott Jr., and R. B. Seymour. 2003. *Terrestrial activity and conservation of adult California red-legged frogs* Rana aurora draytonii *in coastal forests and grasslands*. Biological Conservation. 110(1): 85-95.

California Department of Water Resources. 2018. California Data Exchange Center (CDEC) Las Cumbres (LCM) Station. Available at http://cdec.water.ca.gov/cdecstation2/. Accessed February 13, 2018.

California Invasive Plant Council (Cal-IPC). 2004. *Weed Worker's Handbook*. The Watershed Project and California Invasive Plant Council. Available at http://www.cal-ipc.org/ip/management/wwh/pdf/19651.pdf. Last updated May 2004. Accessed June 24, 2008.

California Invasive Plant Council (Cal-IPC). 2006. California Invasive Plant Inventory. Cal-IPC Publication 2006-02. California Invasive Plant Council: Berkeley, CA.

California Wetlands Monitoring Workgroup (CWMW). 2008. *California Rapid Assessment Methods (CRAM) for Wetlands User's Manual, Version 5.0.2.*

California Wetlands Monitoring Workgroup (CWMW). 2013. California *Rapid Assessment Method (CRAM) for Wetlands and Riparian Areas,* Version 6.1.

California Wetlands Monitoring Workgroup (CWMW). 2013. *California Rapid Assessment Method for Wetlands*, v. 6.1, Riverine Wetlands Field Book. January 2013.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States.* U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC.

DWR. *See* California Department of Water Resources.

Fellers, G. M., and P. M. Kleeman. 2007. *California red-legged frog (Rana draytonii) movement and habitat use: Implications for Conservation.*

Garza, J. C and D. A. Pearse. 2008. *Population genetics of Oncorhynchus mykiss in the Santa Clara Valley Region.* Santa Clara Valley Water District.

Jennings, M. R., and M. P. Hayes. 1988. *Natural history and decline of native Ranids in California*. Pages 61–72. In H. F. De Lisle, P. B. Brown, B. Kaufman, and B. M. McGurty (Eds.), Conference on California Herpetology. Southwestern Herpetologists Society, Special Publication (4). Van Nuys, California, U.S.A.

———. 1990. *Status of the California red-legged frog* (Rana aurora draytonii) *in the Pescadero Marsh Natural Preserve*. California Department of Fish and Game, Inland Fisheries Division. Rancho Cordova, CA. Prepared for the California Department of Parks and Recreation, Sacramento, CA.

Jennings, M. R. 2006. *California Red-Legged Frog (*Rana draytonii*) Surveys at the Hanson Permanente Cement Facility, Cupertino, California*. Davis, CA: Rana Resources.

———. 2007. *California Red-Legged Frog (*Rana draytonii*) Surveys at the Hanson Permanente Cement Facility, Cupertino, California*. Davis, CA: Rana Resources.

Leidy, R.A. 2007. *Ecology, Assemblage, Structure, Distribution and Status of Fishes in Streams Tributary to the San Francisco Estuary, California.* San Francisco Estuary Institute. 188 pgs.

Leidy, R.A., G.S. Becker, B.N. Harvey. 2005. *Historical distribution and current status of steelhead/rainbow trout* (Oncorhynchus mykiss) *in streams of the San Francisco Estuary.*

Lehigh Hanson. 2018. Summary of Permanente Creek Streamflow Monitoring (August 2017–February 2018), Technical Memorandum. Prepared by Golder Associates.

Lisle, T.E. 1995. "Effects of Coarse Woody Debris and Its Removal on a Channel Affected by the 1980 Eruption of Mount St. Helens, Washington." *Water Resources Research.* Vol. 31:7 pp 1797–1808.

Smith, D.R., A. Ammann, C. Bartoldus, and M.M. Brinson. 1995. An Approach for Assessing Wetland Functions Using Hydrogeomorphic Classification, Reference Wetlands, and Functional Indices, Technical Report WRP-DE-9, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. NTIS No. AD A307 121.

State Water Quality Control Board. 2007. *San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan).*

SWQCB. *See* State Water Quality Control Board.

U.S. Army Corps of Engineers (USACE). 2012. Standard Operating Procedure for Determination of Mitigation Ratios. February 20, 2012. South Pacific Division, San Francisco, CA.

U.S. Environmental Protection Agency (EPA). 2006. Application of Elements of a State Water Monitoring and Assessment Program for Wetlands. Wetlands Division, Office of Wetlands, Oceans, and Watersheds, U.S. Environmental Protection Agency, Washington, DC.

Wegmann, George. Golder Associates. 2018 (February 28). Telephone communication with Sarah Norris of GEI Consultants, Inc. discussing results of stream flow monitoring.

Wegmann, George. Golder Associates. 2017 (November 2). Email communication to Cindy Davis of GEI Consultants, Inc. transmitting flow data at Upper Discharge Location.

Western Regional Climate Center. 2015. Climatological Summary. Station: Black Mountain 2 WSW (040850), CA. Period of Record: July 1948 to June 1995. Available: http://www.wrcc.dri.edu/cgi-bin/cliRECtM.pl?ca0850. Accessed February 13, 2018.

WRCC. See Western Regional Climate Center.

Appendix A. CRAM Data Sheets

Basic Information Sheet: Riverine Wetlands

Assessment Area Name: MS-1	
Project Name: Permanente Creek NPDES Study	
Assessment Area ID #: MS-1	
Project ID #:	**Date:** 02/ 02 /2018
Assessment Team Members for This AA: Sarah Norris, Devin Barry	
Average Bankfull Width: 6'	
Approximate Length of AA (10 times bankfull width, min 100 m, max 200 m)**:** 100 m	
Upstream Point Latitude: 37.31889437	**Longitude:** -122.1255154
Downstream Point Latitude: 37.31785686	**Longitude:** -122.1237495

Wetland Sub-type:

☒ Confined ☐ Non-confined

AA Category:

☐ Restoration ☐ Mitigation ☐ Impacted ☐ Ambient ☐ Reference ☐ Training

☒ Other: NPDES Documentation

Did the river/stream have flowing water at the time of the assessment? ☒ yes ☐ no

What is the apparent hydrologic flow regime of the reach you are assessing?

The hydrologic flow regime of a stream describes the frequency with which the channel conducts water. *Perennial* streams conduct water all year long, whereas *ephemeral* streams conduct water only during and immediately following precipitation events. *Intermittent* streams are dry for part of the year, but conduct water for periods longer than ephemeral streams, as a function of watershed size and water source.

☐ perennial ☒ intermittent ☐ ephemeral

1

Photo Identification Numbers and Description:

	Photo ID No.	Description	Latitude	Longitude	Datum
1		Upstream			
2		Middle Left			
3		Middle Right			
4		Downstream			
5					
6					
7					
8					
9					
10					

Site Location Description:

Comments:

Scoring Sheet: Riverine Wetlands

AA Name: MS-1			**Date:** 2/01/2018
Attribute 1: Buffer and Landscape Context (pp. 11-19)			**Comments**
	Alpha.	Numeric	
Stream Corridor Continuity (D)	A	12	
Buffer:			
Buffer submetric A: Percent of AA with Buffer	A	12	
Buffer submetric B: Average Buffer Width	A	12	
Buffer submetric C: Buffer Condition	A	12	
Raw Attribute Score = D+[C x (A x B)$^{1/2}$]$^{1/2}$		12	**Final Attribute Score = (Raw Score/24) x 100** 100
Attribute 2: Hydrology (pp. 20-26)			
	Alpha.	Numeric	
Water Source	A	12	High in watershed, headwaters
Channel Stability	A	12	
Hydrologic Connectivity	A	12	
Raw Attribute Score = sum of numeric scores		36	**Final Attribute Score = (Raw Score/36) x 100** 100
Attribute 3: Physical Structure (pp. 27-33)			
	Alpha.	Numeric	
Structural Patch Richness	A	12	
Topographic Complexity	B	9	
Raw Attribute Score = sum of numeric scores		21	**Final Attribute Score = (Raw Score/24) x 100** 87.5
Attribute 4: Biotic Structure (pp. 34-41)			
Plant Community Composition (based on sub-metrics A-C)			
	Alpha.	Numeric	
Plant Community submetric A: Number of plant layers	A	12	4 layers (short, medium tall, very tall)
Plant Community submetric B: Number of Co-dominant species	A	12	12 co-dom species
Plant Community submetric C: Percent Invasion	A	12	
Plant Community Composition Metric *(numeric average of submetrics A-C)*		12	
Horizontal Interspersion	B	9	
Vertical Biotic Structure	B	9	
Raw Attribute Score = sum of numeric scores		30	**Final Attribute Score = (Raw Score/36) x 100** 83.3
Overall AA Score (average of four final Attribute Scores)			92.7

3

Worksheet for Stream Corridor Continuity Metric for Riverine Wetlands

Lengths of Non-buffer Segments For Distance of 500 m Upstream of AA		Lengths of Non-buffer Segments For Distance of 500 m Downstream of AA	
Segment No.	Length (m)	Segment No.	Length (m)
1		1	
2		2	
3		3	
4		4	
5		5	
Upstream Total Length	0	Downstream Total Length	0

Percent of AA with Buffer Worksheet

In the space provided below make a quick sketch of the AA, or perform the assessment directly on the aerial imagery; indicate where buffer is present, estimate the percentage of the AA perimeter providing buffer functions, and record the estimate amount in the space provided.

Percent of AA with Buffer: ______ %

Worksheet for calculating average buffer width of AA

Line	Buffer Width (m)
A	250
B	250
C	250
D	250
E	185
F	183
G	177
H	188
Average Buffer Width *Round to the nearest integer*	217

4

Worksheet for Assessing Channel Stability for Riverine Wetlands

Condition	Field Indicators (check all existing conditions)
Indicators of Channel Equilibrium	☒ The channel (or multiple channels in braided systems) has a well-defined bankfull contour that clearly demarcates an obvious active floodplain in the cross-sectional profile of the channel throughout most of the AA. ☒ Perennial riparian vegetation is abundant and well established along the bankfull contour, but not below it. ☐ There is leaf litter, thatch, or wrack in most pools (if pools are present). ☒ The channel contains embedded woody debris of the size and amount consistent with what is naturally available in the riparian area. ☐ There is little or no active undercutting or burial of riparian vegetation. ☐ If mid-channel bars and/or point bars are present, they are not densely vegetated with perennial vegetation. ☐ Channel bars consist of well-sorted bed material (smaller grain size on the top and downstream end of the bar, larger grain size along the margins and upstream end of the bar). ☒ There are channel pools, the spacing between pools tends to be regular and the bed is not planar throughout the AA ☐ The larger bed material supports abundant mosses or periphyton.
Indicators of Active Degradation	☒ The channel is characterized by deeply undercut banks with exposed living roots of trees or shrubs. ☐ There are abundant bank slides or slumps. ☒ The lower banks are uniformly scoured and not vegetated. ☐ Riparian vegetation is declining in stature or vigor, or many riparian trees and shrubs along the banks are leaning or falling into the channel. ☐ An obvious historical floodplain has recently been abandoned, as indicated by the age structure of its riparian vegetation. ☐ The channel bed appears scoured to bedrock or dense clay. ☐ Recently active flow pathways appear to have coalesced into one channel (i.e. a previously braided system is no longer braided). ☐ The channel has one or more knickpoints indicating headward erosion of the bed.
Indicators of Active Aggradation	☐ There is an active floodplain with fresh splays of coarse sediment (sand and larger that is not vegetated) deposited in the current or previous year. ☐ There are partially buried living tree trunks or shrubs along the banks. ☐ The bed is planar (flat or uniform gradient) overall; it lacks well-defined channel pools, or they are uncommon and irregularly spaced. ☐ There are partially buried, or sediment-choked, culverts. ☐ Perennial terrestrial or riparian vegetation is encroaching into the channel or onto channel bars below the bankfull contour. ☐ There are avulsion channels on the floodplain or adjacent valley floor.
Overall	☒ **Equilibrium** ☐ **Degradation** ☐ **Aggradation**

5

Riverine Wetland Entrenchment Ratio Calculation Worksheet

The following 5 steps should be conducted for each of 3 cross-sections located in the AA at the approximate midpoints along straight riffles or glides, away from deep pools or meander bends. An attempt should be made to place them at the top, middle, and bottom of the AA.

Steps	Replicate Cross-sections →	TOP	MID	BOT
1 Estimate bankfull width.	This is a critical step requiring familiarity with field indicators of the bankfull contour. Estimate or measure the distance between the right and left bankfull contours.	6'		6'
2: Estimate max. bankfull depth.	Imagine a level line between the right and left bankfull contours; estimate or measure the height of the line above the thalweg (the deepest part of the channel).	32"		20"
3: Estimate flood prone depth.	Double the estimate of maximum bankfull depth from Step 2.	64"		
4: Estimate flood prone width.	Imagine a level line having a height equal to the flood prone depth from Step 3; note where the line intercepts the right and left banks; estimate or measure the length of this line.	13'		12'
5: Calculate entrenchment ratio.	Divide the flood prone width (Step 4) by the bankfull width (Step 1).	2.16		2.0
6: Calculate average entrenchment ratio.	Calculate the average results for Step 5 for all 3 replicate cross-sections. Enter the average result here and use it in Table 13a or 13b.			2.08

6

Structural Patch Type Worksheet for Riverine wetlands

Circle each type of patch that is observed in the AA and enter the total number of observed patches in Table below. In the case of riverine wetlands, their status as confined or non-confined must first be determined (see page 6) to determine with patches are expected in the system (indicated by a "1" in the table below). Any feature onsite should only be counted once as a patch type. If a feature appears to meet the definition of more than one patch type (i.e. swale and secondary channel) the practitioner should choose which patch type best illustrates the feature. Not all features at a site will be patch types.

**Please refer to the CRAM Photo Dictionary at www.cramwetlands.org for photos of each of the following patch types.*

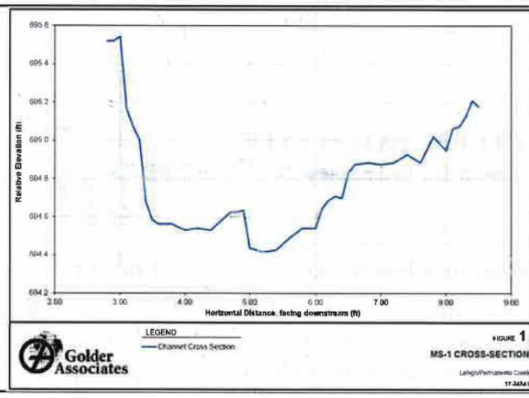
STRUCTURAL PATCH TYPE (circle for presence)	Riverine (Non-confined)	Riverine (Confined)
Minimum Patch Size	$3\ m^2$	$3\ m^2$
Abundant wrackline or organic debris in channel, on floodplain	1	1
Bank slumps or undercut banks in channels or along shoreline	1	1
Cobbles and/or Boulders	1	1
Debris jams	1	1
Filamentous macroalgae or algal mats	1	1
Large woody debris	1	1
Pannes or pools on floodplain	1	N/A
Plant hummocks and/or sediment mounds	1	1
Point bars and in-channel bars	1	1
Pools or depressions in channels (wet or dry channels)	1	1
Riffles or rapids (wet or dry channels)	1	1
Secondary channels on floodplains or along shorelines	1	N/A
Standing snags (at least 3 m tall)	1	1
Submerged vegetation	1	N/A
Swales on floodplain or along shoreline	1	N/A
Variegated, convoluted, or crenulated foreshore (instead of broadly arcuate or mostly straight)	1	1
Vegetated islands (mostly above high-water)	1	N/A
Total Possible	17	12
No. Observed Patch Types (enter here and use in Table 14 below)		9

7

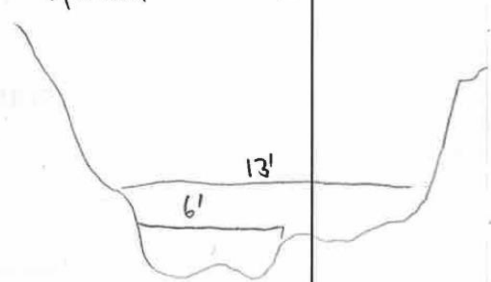
Worksheet for AA Topographic Complexity

At three locations along the AA, make a sketch of the profile of the stream from the AA boundary down to its deepest area then back out to the other AA boundary. Try to capture the benches and the intervening micro-topographic relief. To maintain consistency, make drawings at each of the stream hydrologic connectivity measurements, always facing downstream. Include the water level, an arrow at the bankfull contour, and label the benches. Based on these sketches and the profiles in Figure 10, choose a description in Table 16 that best describes the overall topographic complexity of the AA.

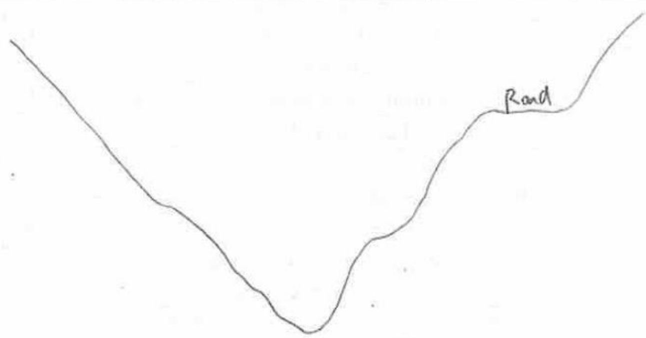
Profile 1 S



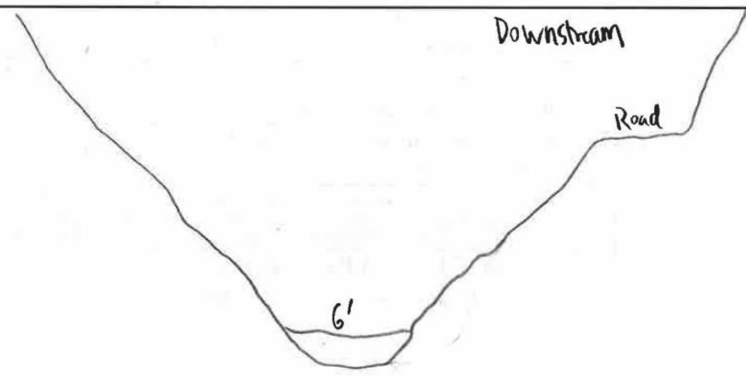
Upstream N



Profile 2



Profile 3 S Downstream N



8

MS-1

Plant Community Metric Worksheet: Co-dominant species richness for Riverine wetlands
(A dominant species represents ≥10% *relative* cover)

Special Note:

* *Combine the counts of co-dominant species from all layers to identify the total species count. Each plant species is only counted once when calculating the Number of Co-dominant Species and Percent Invasion submetric scores, regardless of the numbers of layers in which it occurs.*

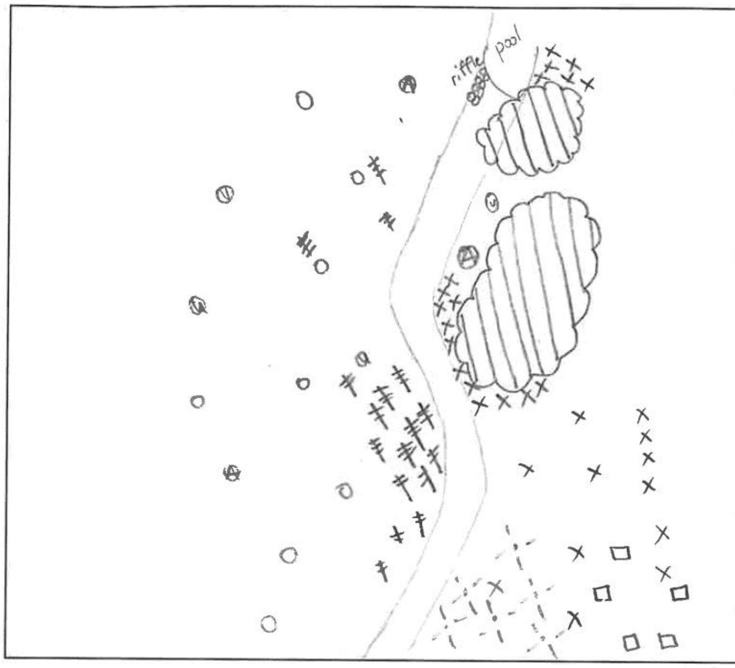
Floating or Canopy-forming (non-confined only)	Invasive?	Short (<0.5 m)	Invasive?
		Rubus ursinus	
		Woodwardia fimbriata	
		Umbellularia californica	
		Gallum aparine	
		Torilis arvensis	
		Stellaria media	
Medium (0.5-1.5 m)	**Invasive?**	**Tall (1.5-3.0 m)**	**Invasive?**
Cornus sericea		Alnus rhombifolia	
Alnus rhombifolia		Umbellularia californica	
Toxicodendron diversilobum		Sambucus nigra (**)	
		Heteromeles arbutifolia (**)	
Very Tall (>3.0 m)	**Invasive?**	**Total number of co-dominant species for all layers combined (enter here and use in Table 18)**	**12**
Umbellularia californica			
Salix laevigata			
Quercus agrifolia		**Percent Invasion *Round to the nearest integer* (enter here and use in Table 18)**	**0**
Acer macrophyllum			

(**) denotes less than 10% cover

9

Horizontal Interspersion Worksheet.

Use the spaces below to make a quick sketch of the AA in plan view, outlining the major plant zones (this should take no longer than 10 minutes). Assign the zones names and record them on the right. Based on the sketch, choose a single profile from Figure 12 that best represents the AA overall.



Assigned zones:

1) = Cornus

2) xxx xxx = Rubus

3) Ⓥ = CA Bay / Ⓐ = Alder

4) = fern

5) □ = Poison oak

6) Herbaceous
- chickweed
- Nemophila
- galium

Worksheet for Wetland disturbances and conversions

Has a major disturbance occurred at this wetland?	Yes	No		
If yes, was it a flood, fire, landslide, or other?	flood	fire	landslide	other
If yes, then how severe is the disturbance? NA	likely to affect site next 5 or more years	likely to affect site next 3-5 years	likely to affect site next 1-2 years	
Has this wetland been converted from another type? If yes, then what was the previous type? No.	depressional	vernal pool	vernal pool system	
	non-confined riverine	confined riverine	seasonal estuarine	
	perennial saline estuarine	perennial non-saline estuarine	wet meadow	
	lacustrine	seep or spring	playa	

Stressor Checklist Worksheet

HYDROLOGY ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Point Source (PS) discharges (POTW, other non-stormwater discharge)		
Non-point Source (Non-PS) discharges (urban runoff, farm drainage)		
Flow diversions or unnatural inflows		
Dams (reservoirs, detention basins, recharge basins)		
Flow obstructions (culverts, paved stream crossings)		
Weir/drop structure, tide gates		
Dredged inlet/channel		
Engineered channel (riprap, armored channel bank, bed)		
Dike/levees		
Groundwater extraction		
Ditches (borrow, agricultural drainage, mosquito control, etc.)		
Actively managed hydrology		
Comments		

PHYSICAL STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Filling or dumping of sediment or soils **(N/A for restoration areas)**		
Grading/ compaction **(N/A for restoration areas)**	y- unpaved access road	
Plowing/Discing **(N/A for restoration areas)**		
Resource extraction (sediment, gravel, oil and/or gas)		
Vegetation management		
Excessive sediment or organic debris from watershed		
Excessive runoff from watershed		
Nutrient impaired (PS or Non-PS pollution)		
Heavy metal impaired (PS or Non-PS pollution)		
Pesticides or trace organics impaired (PS or Non-PS pollution)		
Bacteria and pathogens impaired (PS or Non-PS pollution)		
Trash or refuse		
Comments		
Road unlikley to have significant negative effect since road is subject to infrequent use.		

BIOTIC STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Mowing, grazing, excessive herbivory (within AA)		
Excessive human visitation		
Predation and habitat destruction by non-native vertebrates (e.g., *Virginia opossum* and domestic predators, such as feral pets)		
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species		
Pesticide application or vector control		
Biological resource extraction or stocking (fisheries, aquaculture)		
Excessive organic debris in matrix (for vernal pools)		
Lack of vegetation management to conserve natural resources		
Lack of treatment of invasive plants adjacent to AA or buffer		
Comments		

BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (WITHIN 500 M OF AA)	Present	Significant negative effect on AA
Urban residential		
Industrial/commercial	y- mining	
Military training/Air traffic		
Dams (or other major flow regulation or disruption)		
Dryland farming		
Intensive row-crop agriculture		
Orchards/nurseries		
Commercial feedlots		
Dairies		
Ranching (enclosed livestock grazing or horse paddock or feedlot)		
Transportation corridor		
Rangeland (livestock rangeland also managed for native vegetation)		
Sports fields and urban parklands (golf courses, soccer fields, etc.)		
Passive recreation (bird-watching, hiking, etc.)		
Active recreation (off-road vehicles, mountain biking, hunting, fishing)		
Physical resource extraction (rock, sediment, oil/gas)	y- mining	
Biological resource extraction (aquaculture, commercial fisheries)		
Comments		

Basic Information Sheet: Riverine Wetlands

Assessment Area Name:	MS-US		
Project Name:	Permanente Creek NPDES Study		
Assessment Area ID #:	MS-US		
Project ID #:		**Date:**	02/ 02 /2018
Assessment Team Members for This AA:	Sarah Norris, Devin Barry		
Average Bankfull Width:			
Approximate Length of AA (10 times bankfull width, min 100 m, max 200 m)**:**	100 m		
Upstream Point Latitude:	37.3170820	**Longitude:**	-122.113940
Downstream Point Latitude:	37.31672612	**Longitude:**	-122.111936

Wetland Sub-type:

☒ Confined ☐ Non-confined

AA Category:

☐ Restoration ☐ Mitigation ☐ Impacted ☐ Ambient ☐ Reference ☐ Training

☒ Other: NPDES Documentation

Did the river/stream have flowing water at the time of the assessment? ☐ yes ☐ no

What is the apparent hydrologic flow regime of the reach you are assessing?

The hydrologic flow regime of a stream describes the frequency with which the channel conducts water. *Perennial* streams conduct water all year long, whereas *ephemeral* streams conduct water only during and immediately following precipitation events. *Intermittent* streams are dry for part of the year, but conduct water for periods longer than ephemeral streams, as a function of watershed size and water source.

☐ perennial ☒ intermittent ☐ ephemeral

1

Photo Identification Numbers and Description:

	Photo ID No.	Description	Latitude	Longitude	Datum
1		Upstream			
2		Middle Left			
3		Middle Right			
4		Downstream			
5					
6					
7					
8					
9					
10					

Site Location Description:

Comments:

Scoring Sheet: Riverine Wetlands

AA Name: MS-US			**Date:** 2/01/2018	
Attribute 1: Buffer and Landscape Context (pp. 11-19)			**Comments**	
	Alpha.	Numeric		
Stream Corridor Continuity (D)	A	12		
Buffer:				
	Alpha.	Numeric		
Buffer submetric A: Percent of AA with Buffer	B	9		
Buffer submetric B: Average Buffer Width	B	9		
Buffer submetric C: Buffer Condition	C	6		
Raw Attribute Score = D+[C x (A x B)^{½}]^{½}		19	**Final Attribute Score = (Raw Score/24) x 100**	79.2
Attribute 2: Hydrology (pp. 20-26)				
	Alpha.	Numeric		
Water Source	A	12		
Channel Stability	B	9		
Hydrologic Connectivity	A	12	Entrench ratio 2.5	
Raw Attribute Score = sum of numeric scores		33	**Final Attribute Score = (Raw Score/36) x 100**	91.6
Attribute 3: Physical Structure (pp. 27-33)				
	Alpha.	Numeric		
Structural Patch Richness	B	9	10 patch types	
Topographic Complexity	A	12	2 benches, complex micro topography	
Raw Attribute Score = sum of numeric scores		21	**Final Attribute Score = (Raw Score/24) x 100**	87.5
Attribute 4: Biotic Structure (pp. 34-41)				
Plant Community Composition (based on sub-metrics A-C)				
	Alpha.	Numeric		
Plant Community submetric A: Number of plant layers	A	12	4 layers (short, medium tall, very tall)	
Plant Community submetric B: Number of Co-dominant species	C	6	8 co-dom	
Plant Community submetric C: Percent Invasion	A	12	1 Invasive (B. diandrus)	
Plant Community Composition Metric *(numeric average of submetrics A-C)*		10		
Horizontal Interspersion	B	9		
Vertical Biotic Structure	B	9		
Raw Attribute Score = sum of numeric scores		28	**Final Attribute Score = (Raw Score/36) x 100**	82.3
Overall AA Score (average of four final Attribute Scores)				85.2

3

Worksheet for Stream Corridor Continuity Metric for Riverine Wetlands

Lengths of Non-buffer Segments For Distance of 500 m Upstream of AA		Lengths of Non-buffer Segments For Distance of 500 m Downstream of AA	
Segment No.	Length (m)	Segment No.	Length (m)
1		1	
2		2	
3		3	
4		4	
5		5	
Upstream Total Length	0	Downstream Total Length	0

Percent of AA with Buffer Worksheet

In the space provided below make a quick sketch of the AA, or perform the assessment directly on the aerial imagery; indicate where buffer is present, estimate the percentage of the AA perimeter providing buffer functions, and record the estimate amount in the space provided.

Percent of AA with Buffer: ______ %

Worksheet for calculating average buffer width of AA

Line	Buffer Width (m)
A	250
B	250
C	250
D	250
E	37
F	26
G	26
H	14
Average Buffer Width *Round to the nearest integer*	141

4

Worksheet for Assessing Channel Stability for Riverine Wetlands

Condition	Field Indicators (check all existing conditions)
Indicators of Channel Equilibrium	☒ The channel (or multiple channels in braided systems) has a well-defined bankfull contour that clearly demarcates an obvious active floodplain in the cross-sectional profile of the channel throughout most of the AA. ☐ Perennial riparian vegetation is abundant and well established along the bankfull contour, but not below it. ☐ There is leaf litter, thatch, or wrack in most pools (if pools are present). ☒ The channel contains embedded woody debris of the size and amount consistent with what is naturally available in the riparian area. ☐ There is little or no active undercutting or burial of riparian vegetation. ☐ If mid-channel bars and/or point bars are present, they are not densely vegetated with perennial vegetation. ☐ Channel bars consist of well-sorted bed material (smaller grain size on the top and downstream end of the bar, larger grain size along the margins and upstream end of the bar). ☐ There are channel pools, the spacing between pools tends to be regular and the bed is not planar throughout the AA ☒ The larger bed material supports abundant mosses or periphyton.
Indicators of Active Degradation	☐ The channel is characterized by deeply undercut banks with exposed living roots of trees or shrubs. ☒ There are abundant bank slides or slumps. ☐ The lower banks are uniformly scoured and not vegetated. ☐ Riparian vegetation is declining in stature or vigor, or many riparian trees and shrubs along the banks are leaning or falling into the channel. ☐ An obvious historical floodplain has recently been abandoned, as indicated by the age structure of its riparian vegetation. ☒ The channel bed appears scoured to bedrock or dense clay. ☐ Recently active flow pathways appear to have coalesced into one channel (i.e. a previously braided system is no longer braided). ☐ The channel has one or more knickpoints indicating headward erosion of the bed.
Indicators of Active Aggradation	☐ There is an active floodplain with fresh splays of coarse sediment (sand and larger that is not vegetated) deposited in the current or previous year. ☐ There are partially buried living tree trunks or shrubs along the banks. ☐ The bed is planar (flat or uniform gradient) overall; it lacks well-defined channel pools, or they are uncommon and irregularly spaced. ☐ There are partially buried, or sediment-choked, culverts. ☒ Perennial terrestrial or riparian vegetation is encroaching into the channel or onto channel bars below the bankfull contour. Abundant veg below OHWM ☐ There are avulsion channels on the floodplain or adjacent valley floor.
Overall	☐ **Equilibrium** ☐ **Degradation** ☐ **Aggradation**

5

Riverine Wetland Entrenchment Ratio Calculation Worksheet

The following 5 steps should be conducted for each of 3 cross-sections located in the AA at the approximate midpoints along straight riffles or glides, away from deep pools or meander bends. An attempt should be made to place them at the top, middle, and bottom of the AA.				
Steps	**Replicate Cross-sections** →	**TOP**	**MID**	**BOT**
1 Estimate bankfull width.	This is a critical step requiring familiarity with field indicators of the bankfull contour. Estimate or measure the distance between the right and left bankfull contours.	9'	20'	
2: Estimate max. bankfull depth.	Imagine a level line between the right and left bankfull contours; estimate or measure the height of the line above the thalweg (the deepest part of the channel).	26"		
3: Estimate flood prone depth.	Double the estimate of maximum bankfull depth from Step 2.	52"		
4: Estimate flood prone width.	Imagine a level line having a height equal to the flood prone depth from Step 3; note where the line intercepts the right and left banks; estimate or measure the length of this line.	23'	50'	
5: Calculate entrenchment ratio.	Divide the flood prone width (Step 4) by the bankfull width (Step 1).	2.5	2.5	
6: Calculate average entrenchment ratio.	Calculate the average results for Step 5 for all 3 replicate cross-sections. Enter the average result here and use it in Table 13a or 13b.			2.5

6

Structural Patch Type Worksheet for Riverine wetlands

Circle each type of patch that is observed in the AA and enter the total number of observed patches in Table below. In the case of riverine wetlands, their status as confined or non-confined must first be determined (see page 6) to determine with patches are expected in the system (indicated by a "1" in the table below). Any feature onsite should only be counted once as a patch type. If a feature appears to meet the definition of more than one patch type (i.e. swale and secondary channel) the practitioner should choose which patch type best illustrates the feature. Not all features at a site will be patch types.

Please refer to the CRAM Photo Dictionary at www.cramwetlands.org for photos of each of the following patch types.

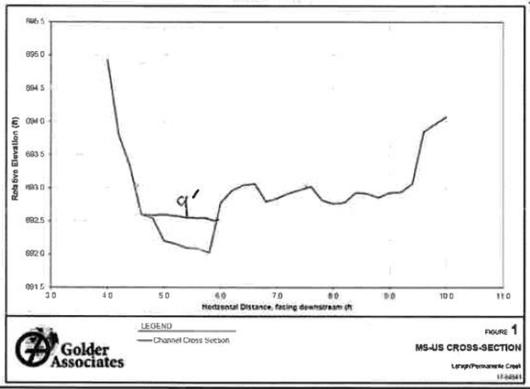
STRUCTURAL PATCH TYPE (circle for presence)	Riverine (Non-confined)	Riverine (Confined)
Minimum Patch Size	**3 m^2**	**3 m^2**
Abundant wrackline or organic debris in channel, on floodplain	1	1
Bank slumps or undercut banks in channels or along shoreline	1	1
Cobbles and/or Boulders	1	1
Debris jams	1	1
Filamentous macroalgae or algal mats	1	1
Large woody debris	1	1
Pannes or pools on floodplain	1	N/A
Plant hummocks and/or sediment mounds	1	1
Point bars and in-channel bars	1	1
Pools or depressions in channels (wet or dry channels)	1	1
Riffles or rapids (wet or dry channels)	1	1
Secondary channels on floodplains or along shorelines	1	N/A
Standing snags (at least 3 m tall)	1	1
Submerged vegetation	1	N/A
Swales on floodplain or along shoreline	1	N/A
Variegated, convoluted, or crenulated foreshore (instead of broadly arcuate or mostly straight)	1	1
Vegetated islands (mostly above high-water)	1	N/A
Total Possible	**17**	**12**
No. Observed Patch Types (enter here and use in Table 14 below)	10	

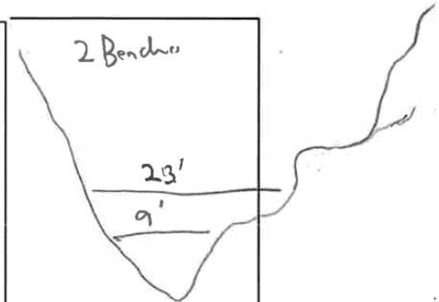
7

Worksheet for AA Topographic Complexity

At three locations along the AA, make a sketch of the profile of the stream from the AA boundary down to its deepest area then back out to the other AA boundary. Try to capture the benches and the intervening micro-topographic relief. To maintain consistency, make drawings at each of the stream hydrologic connectivity measurements, always facing downstream. Include the water level, an arrow at the bankfull contour, and label the benches. Based on these sketches and the profiles in Figure 10, choose a description in Table 16 that best describes the overall topographic complexity of the AA.

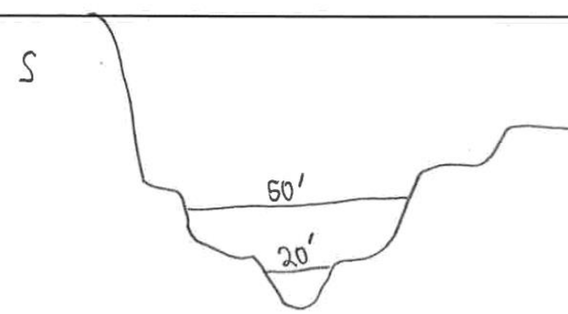
Profile 1





Profile 2

Profile 3



8

Plant Community Metric Worksheet: Co-dominant species richness for Riverine wetlands
(A dominant species represents ≥10% *relative* cover)

Special Note:

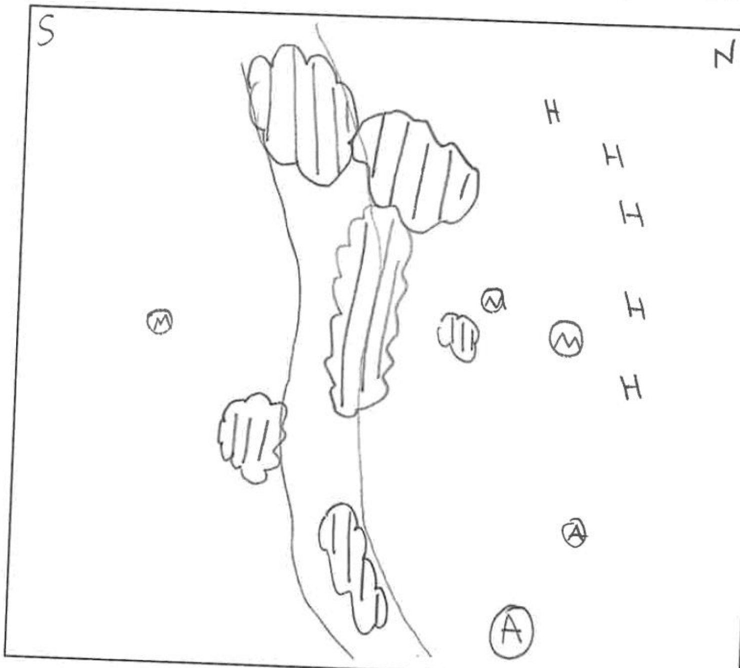
* *Combine the counts of co-dominant species from all layers to identify the total species count. Each plant species is only counted once when calculating the Number of Co-dominant Species and Percent Invasion submetric scores, regardless of the numbers of layers in which it occurs.*

Floating or Canopy-forming (non-confined only)	Invasive?	Short (<0.5 m)	Invasive?
		Adenostoma fasciculatum	
		Torilis arvensis	
		Eriophyllum confertiflorum	
		Bromus diandrus	
Medium (0.5-1.5 m)	**Invasive?**	**Tall (1.5-3.0 m)**	**Invasive?**
Baccharis pilularis		Salix lasiolepis	
		Arbutus menziesii	
		Acer macrophyllum	
Very Tall (>3.0 m)	**Invasive?**	**Total number of co-dominant species for all layers combined (enter here and use in Table 18)**	8
Acer macrophyllum			
		Percent Invasion *Round to the nearest integer* (enter here and use in Table 18)	13%

9

Horizontal Interspersion Worksheet.

Use the spaces below to make a quick sketch of the AA in plan view, outlining the major plant zones (this should take no longer than 10 minutes). Assign the zones names and record them on the right. Based on the sketch, choose a single profile from Figure 12 that best represents the AA overall.



Assigned zones:

1) = Shrub willow /Bacc

2) M = Madrone
A = Acer mac.

3) H = herb

4)

5)

6)

Worksheet for Wetland disturbances and conversions

Has a major disturbance occurred at this wetland?	Yes	No		
If yes, was it a flood, fire, landslide, or other?	flood	fire	landslide	other
If yes, then how severe is the disturbance?	likely to affect site next 5 or more years	likely to affect site next 3-5 years	likely to affect site next 1-2 years	
Has this wetland been converted from another type? If yes, then what was the previous type?	depressional	vernal pool	vernal pool system	
	non-confined riverine	confined riverine	seasonal estuarine	
	perennial saline estuarine	perennial non-saline estuarine	wet meadow	
	lacustrine	seep or spring	playa	

10

Stressor Checklist Worksheet

HYDROLOGY ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Point Source (PS) discharges (POTW, other non-stormwater discharge)	y- Upper Discharge Location downstream of AA	
Non-point Source (Non-PS) discharges (urban runoff, farm drainage)		
Flow diversions or unnatural inflows		
Dams (reservoirs, detention basins, recharge basins)		
Flow obstructions (culverts, paved stream crossings)		
Weir/drop structure, tide gates		
Dredged inlet/channel		
Engineered channel (riprap, armored channel bank, bed)		
Dike/levees		
Groundwater extraction		
Ditches (borrow, agricultural drainage, mosquito control, etc.)		
Actively managed hydrology		
Comments		

PHYSICAL STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Filling or dumping of sediment or soils **(N/A for restoration areas)**	y-slope erosion along N bank	
Grading/ compaction **(N/A for restoration areas)**		
Plowing/Discing **(N/A for restoration areas)**		
Resource extraction (sediment, gravel, oil and/or gas)		
Vegetation management		
Excessive sediment or organic debris from watershed	y-slope erosion along S bank due to steep slopes	
Excessive runoff from watershed		
Nutrient impaired (PS or Non-PS pollution)		
Heavy metal impaired (PS or Non-PS pollution)		
Pesticides or trace organics impaired (PS or Non-PS pollution)		
Bacteria and pathogens impaired (PS or Non-PS pollution)		
Trash or refuse	y- historic debris	
Comments		

BIOTIC STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Mowing, grazing, excessive herbivory (within AA)		
Excessive human visitation		
Predation and habitat destruction by non-native vertebrates (e.g., *Virginia opossum* and domestic predators, such as feral pets)		
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species		
Pesticide application or vector control		
Biological resource extraction or stocking (fisheries, aquaculture)		
Excessive organic debris in matrix (for vernal pools)		
Lack of vegetation management to conserve natural resources		
Lack of treatment of invasive plants adjacent to AA or buffer		
Comments		

BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (WITHIN 500 M OF AA)	Present	Significant negative effect on AA
Urban residential		
Industrial/commercial		
Military training/Air traffic		
Dams (or other major flow regulation or disruption)		
Dryland farming		
Intensive row-crop agriculture		
Orchards/nurseries		
Commercial feedlots		
Dairies		
Ranching (enclosed livestock grazing or horse paddock or feedlot)		
Transportation corridor		
Rangeland (livestock rangeland also managed for native vegetation)		
Sports fields and urban parklands (golf courses, soccer fields, etc.)		
Passive recreation (bird-watching, hiking, etc.)		
Active recreation (off-road vehicles, mountain biking, hunting, fishing)		
Physical resource extraction (rock, sediment, oil/gas)		
Biological resource extraction (aquaculture, commercial fisheries)		
Comments		

Basic Information Sheet: Riverine Wetlands

Assessment Area Name:	Upper Discharge Location
Project Name:	Permanente Creek NPDES Study
Assessment Area ID #:	Upper Discharge Location
Project ID #:	**Date:** 02/ 012 /2018
Assessment Team Members for This AA:	Sarah Norris, Devin Barry
Average Bankfull Width:	
Approximate Length of AA (10 times bankfull width, min 100 m, max 200 m)**:**	100 m
Upstream Point Latitude: 37.31660321	**Longitude:** -122.1124568
Downstream Point Latitude: 37.317120	**Longitude:** -122.1103715

Wetland Sub-type:

☐ Confined ☒ Non-confined

AA Category:

☐ Restoration ☐ Mitigation ☐ Impacted ☐ Ambient ☐ Reference ☐ Training

☒ Other: NPDES Documentation

Did the river/stream have flowing water at the time of the assessment? ☒ yes ☐ no

What is the apparent hydrologic flow regime of the reach you are assessing?

The hydrologic flow regime of a stream describes the frequency with which the channel conducts water. *Perennial* streams conduct water all year long, whereas *ephemeral* streams conduct water only during and immediately following precipitation events. *Intermittent* streams are dry for part of the year, but conduct water for periods longer than ephemeral streams, as a function of watershed size and water source.

☒ perennial ☐ intermittent ☐ ephemeral

Existing Upper Discharge Location

1

Photo Identification Numbers and Description:

	Photo ID No.	Description	Latitude	Longitude	Datum
1		Upstream			
2		Middle Left			
3		Middle Right			
4		Downstream			
5					
6					
7					
8					
9					
10					

Site Location Description:

Comments:

2

Scoring Sheet: Riverine Wetlands

AA Name: Upper Discharge Location					**Date:** 2/01/2018	
Attribute 1: Buffer and Landscape Context (pp. 11-19)					**Comments**	
			Alpha.	Numeric		
Stream Corridor Continuity (D)			A	12		
Buffer:						
	Alpha.	Numeric				
Buffer submetric A: Percent of AA with Buffer	B	9				
Buffer submetric B: Average Buffer Width	B	9				
Buffer submetric C: Buffer Condition	C	6				
Raw Attribute Score = D+[C x (A x B)^{½}]^{½}				19	**Final Attribute Score = (Raw Score/24) x 100**	79.2
Attribute 2: Hydrology (pp. 20-26)						
			Alpha.	Numeric		
Water Source			C	6		
Channel Stability			B	9		
Hydrologic Connectivity			A	12	Entrench ratio 2.3	
Raw Attribute Score = sum of numeric scores				27	**Final Attribute Score = (Raw Score/36) x 100**	75
Attribute 3: Physical Structure (pp. 27-33)						
			Alpha.	Numeric		
Structural Patch Richness			B	9	10 patch types	
Topographic Complexity			B	9	Complex microtopography, 1 bench	
Raw Attribute Score = sum of numeric scores				18	**Final Attribute Score = (Raw Score/24) x 100**	75
Attribute 4: Biotic Structure (pp. 34-41)						
Plant Community Composition (based on sub-metrics A-C)						
	Alpha.	Numeric				
Plant Community submetric A: Number of plant layers	A	12			4 layers (short, medium tall, very tall)	
Plant Community submetric B: Number of Co-dominant species	B	9			10 co-dom species	
Plant Community submetric C: Percent Invasion	A	12				
Plant Community Composition Metric *(numeric average of submetrics A-C)*				11		
Horizontal Interspersion			B	9		
Vertical Biotic Structure			B	9		
Raw Attribute Score = sum of numeric scores				29	**Final Attribute Score = (Raw Score/36) x 100**	80.5
Overall AA Score (average of four final Attribute Scores)					77.4	

3

Worksheet for Stream Corridor Continuity Metric for Riverine Wetlands

Lengths of Non-buffer Segments For Distance of 500 m Upstream of AA		Lengths of Non-buffer Segments For Distance of 500 m Downstream of AA	
Segment No.	Length (m)	Segment No.	Length (m)
1		1	
2		2	
3		3	
4		4	
5		5	
Upstream Total Length	0	Downstream Total Length	0

Percent of AA with Buffer Worksheet

In the space provided below make a quick sketch of the AA, or perform the assessment directly on the aerial imagery; indicate where buffer is present, estimate the percentage of the AA perimeter providing buffer functions, and record the estimate amount in the space provided.

Percent of AA with Buffer: ______ %

Worksheet for calculating average buffer width of AA

Line	Buffer Width (m)
A	250
B	250
C	250
D	250
E	15
F	22
G	50
H	49
Average Buffer Width *Round to the nearest integer*	142

4

Worksheet for Assessing Channel Stability for Riverine Wetlands

Condition	Field Indicators (check all existing conditions)
Indicators of Channel Equilibrium	☐ The channel (or multiple channels in braided systems) has a well-defined bankfull contour that clearly demarcates an obvious active floodplain in the cross-sectional profile of the channel throughout most of the AA. ☐ Perennial riparian vegetation is abundant and well established along the bankfull contour, but not below it. ☒ There is leaf litter, thatch, or wrack in most pools (if pools are present). ☒ The channel contains embedded woody debris of the size and amount consistent with what is naturally available in the riparian area. ☐ There is little or no active undercutting or burial of riparian vegetation. ☐ If mid-channel bars and/or point bars are present, they are not densely vegetated with perennial vegetation. ☐ Channel bars consist of well-sorted bed material (smaller grain size on the top and downstream end of the bar, larger grain size along the margins and upstream end of the bar). ☐ There are channel pools, the spacing between pools tends to be regular and the bed is not planar throughout the AA ☐ The larger bed material supports abundant mosses or periphyton.
Indicators of Active Degradation	☐ The channel is characterized by deeply undercut banks with exposed living roots of trees or shrubs. ☒ There are abundant bank slides or slumps. ☐ The lower banks are uniformly scoured and not vegetated. ☐ Riparian vegetation is declining in stature or vigor, or many riparian trees and shrubs along the banks are leaning or falling into the channel. ☐ An obvious historical floodplain has recently been abandoned, as indicated by the age structure of its riparian vegetation. ☐ The channel bed appears scoured to bedrock or dense clay. ☐ Recently active flow pathways appear to have coalesced into one channel (i.e. a previously braided system is no longer braided). ☐ The channel has one or more knickpoints indicating headward erosion of the bed.
Indicators of Active Aggradation	☐ There is an active floodplain with fresh splays of coarse sediment (sand and larger that is not vegetated) deposited in the current or previous year. ☐ There are partially buried living tree trunks or shrubs along the banks. ☐ The bed is planar (flat or uniform gradient) overall; it lacks well-defined channel pools, or they are uncommon and irregularly spaced. ☐ There are partially buried, or sediment-choked, culverts. ☒ Perennial terrestrial or riparian vegetation is encroaching into the channel or onto channel bars below the bankfull contour. Abundant and very dense ☐ There are avulsion channels on the floodplain or adjacent valley floor.
Overall	☐ **Equilibrium** ☐ **Degradation** ☐ **Aggradation**

5

Riverine Wetland Entrenchment Ratio Calculation Worksheet

<table>
<tr><td colspan="5">The following 5 steps should be conducted for each of 3 cross-sections located in the AA at the approximate midpoints along straight riffles or glides, away from deep pools or meander bends. An attempt should be made to place them at the top, middle, and bottom of the AA.</td></tr>
<tr><th>Steps</th><th>Replicate Cross-sections →</th><th>TOP</th><th>MID</th><th>BOT</th></tr>
<tr><td>1 Estimate bankfull width.</td><td>This is a critical step requiring familiarity with field indicators of the bankfull contour. Estimate or measure the distance between the right and left bankfull contours.</td><td>15'</td><td></td><td></td></tr>
<tr><td>2: Estimate max. bankfull depth.</td><td>Imagine a level line between the right and left bankfull contours; estimate or measure the height of the line above the thalweg (the deepest part of the channel).</td><td>28"</td><td></td><td></td></tr>
<tr><td>3: Estimate flood prone depth.</td><td>Double the estimate of maximum bankfull depth from Step 2.</td><td>56"</td><td></td><td></td></tr>
<tr><td>4: Estimate flood prone width.</td><td>Imagine a level line having a height equal to the flood prone depth from Step 3; note where the line intercepts the right and left banks; estimate or measure the length of this line.</td><td>35'</td><td></td><td></td></tr>
<tr><td>5: Calculate entrenchment ratio.</td><td>Divide the flood prone width (Step 4) by the bankfull width (Step 1).</td><td>2.3</td><td></td><td></td></tr>
<tr><td>6: Calculate average entrenchment ratio.</td><td colspan="3">Calculate the average results for Step 5 for all 3 replicate cross-sections. Enter the average result here and use it in Table 13a or 13b.</td><td>2.3</td></tr>
</table>

Most of AA is very densely vegetated with Salix spp. below plane of OHWM, preventing multiple channel measurements.

6

Structural Patch Type Worksheet for Riverine wetlands

Circle each type of patch that is observed in the AA and enter the total number of observed patches in Table below. In the case of riverine wetlands, their status as confined or non-confined must first be determined (see page 6) to determine with patches are expected in the system (indicated by a "1" in the table below). Any feature onsite should only be counted once as a patch type. If a feature appears to meet the definition of more than one patch type (i.e. swale and secondary channel) the practitioner should choose which patch type best illustrates the feature. Not all features at a site will be patch types.

****Please refer to the CRAM Photo Dictionary at** www.cramwetlands.org **for photos of each of the following patch types.***

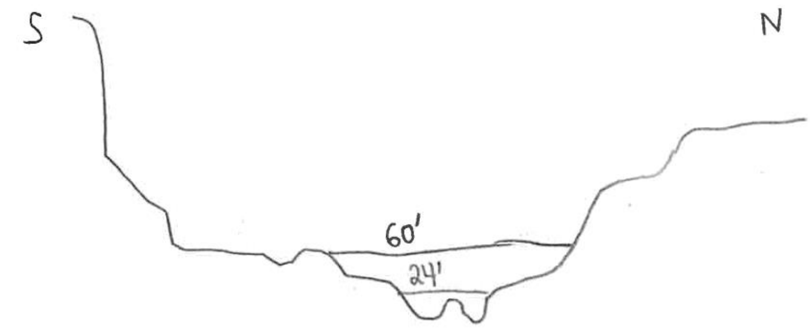
STRUCTURAL PATCH TYPE (circle for presence)	**Riverine (Non-confined)**	**Riverine (Confined)**
Minimum Patch Size	**3 m^2**	**3 m^2**
Abundant wrackline or organic debris in channel, on floodplain	1	1
Bank slumps or undercut banks in channels or along shoreline	1	1
Cobbles and/or Boulders	1	1
Debris jams	1	1
Filamentous macroalgae or algal mats	1	1
Large woody debris	1	1
Pannes or pools on floodplain	1	N/A
Plant hummocks and/or sediment mounds	1	1
Point bars and in-channel bars	1	1
Pools or depressions in channels (wet or dry channels)	1	1
Riffles or rapids (wet or dry channels)	1	1
Secondary channels on floodplains or along shorelines	1	N/A
Standing snags (at least 3 m tall)	1	1
Submerged vegetation	1	N/A
Swales on floodplain or along shoreline	1	N/A
Variegated, convoluted, or crenulated foreshore (instead of broadly arcuate or mostly straight)	1	1
Vegetated islands (mostly above high-water)	1	N/A
Total Possible	**17**	**12**
No. Observed Patch Types (enter here and use in Table 14 below)	10	

7

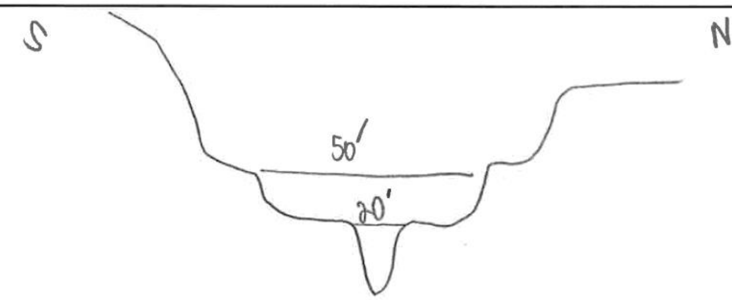
Worksheet for AA Topographic Complexity

At three locations along the AA, make a sketch of the profile of the stream from the AA boundary down to its deepest area then back out to the other AA boundary. Try to capture the benches and the intervening micro-topographic relief. To maintain consistency, make drawings at each of the stream hydrologic connectivity measurements, always facing downstream. Include the water level, an arrow at the bankfull contour, and label the benches. Based on these sketches and the profiles in Figure 10, choose a description in Table 16 that best describes the overall topographic complexity of the AA.

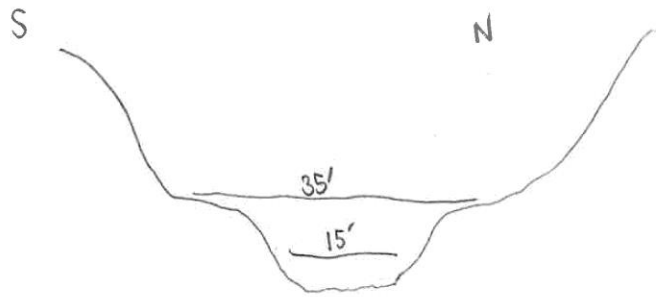
Profile 1



Profile 2



Profile 3



8

Plant Community Metric Worksheet: Co-dominant species richness for Riverine wetlands
(A dominant species represents ≥10% *relative* cover)

Special Note:

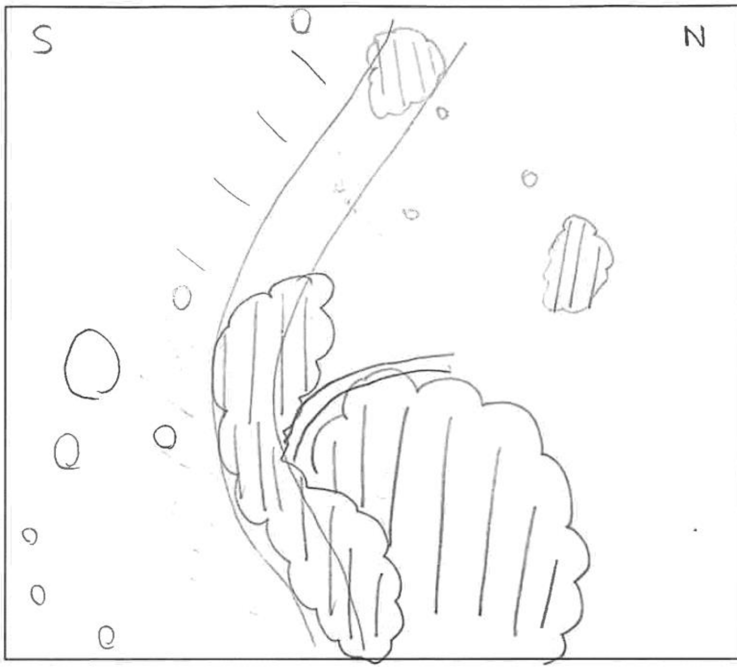
* *Combine the counts of co-dominant species from all layers to identify the total species count. Each plant species is only counted once when calculating the Number of Co-dominant Species and Percent Invasion submetric scores, regardless of the numbers of layers in which it occurs.*

Floating or Canopy-forming (non-confined only)	Invasive?	Short (<0.5 m)	Invasive?
		Eriophyllum confertiflorum	
		Delphinium nudicaule	
		Woodwardia fimbriata	
Medium (0.5-1.5 m)	**Invasive?**	**Tall (1.5-3.0 m)**	**Invasive?**
Baccharis pilularis		Umbellularia californica	
Umbellularia californica		Salix lasiandra	
Arbutus menziesii		Salix lasiolepis	
Very Tall (>3.0 m)	**Invasive?**	**Total number of co-dominant species for all layers combined (enter here and use in Table 18)**	10
Alnus rhombifolia			
Acer macrophyllum			
		Percent Invasion *Round to the nearest integer* (enter here and use in Table 18)	0

9

Horizontal Interspersion Worksheet.

Use the spaces below to make a quick sketch of the AA in plan view, outlining the major plant zones (this should take no longer than 10 minutes). Assign the zones names and record them on the right. Based on the sketch, choose a single profile from Figure 12 that best represents the AA overall.



Assigned zones:

1) // exposed bedrock
2) O = tree
3) Shrub
4) (Herb)
5)
6)

Worksheet for Wetland disturbances and conversions

Has a major disturbance occurred at this wetland?	Yes	No		
If yes, was it a flood, fire, landslide, or other?	flood	fire	landslide	other
If yes, then how severe is the disturbance?	likely to affect site next 5 or more years	likely to affect site next 3-5 years	likely to affect site next 1-2 years	
Has this wetland been converted from another type? If yes, then what was the previous type?	depressional	vernal pool	vernal pool system	
	non-confined riverine	confined riverine	seasonal estuarine	
	perennial saline estuarine	perennial non-saline estuarine	wet meadow	
	lacustrine	seep or spring	playa	

10

Stressor Checklist Worksheet

Note: EFF-001 refers to Upper Discharge Location

HYDROLOGY ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Point Source (PS) discharges (POTW, other non-stormwater discharge)	EFF-001 is existing discharge location of treated quarry water	
Non-point Source (Non-PS) discharges (urban runoff, farm drainage)		
Flow diversions or unnatural inflows	y- EFF-001 is existing discharge location of treated quarry water	
Dams (reservoirs, detention basins, recharge basins)		
Flow obstructions (culverts, paved stream crossings)		
Weir/drop structure, tide gates		
Dredged inlet/channel		
Engineered channel (riprap, armored channel bank, bed)		
Dike/levees		
Groundwater extraction		
Ditches (borrow, agricultural drainage, mosquito control, etc.)		
Actively managed hydrology	y- EFF-001 is existing discharge location of treated quarry water	
Comments		

PHYSICAL STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Filling or dumping of sediment or soils **(N/A for restoration areas)**	y	
Grading/ compaction **(N/A for restoration areas)**		
Plowing/Discing **(N/A for restoration areas)**		
Resource extraction (sediment, gravel, oil and/or gas)		
Vegetation management		
Excessive sediment or organic debris from watershed	y	
Excessive runoff from watershed		
Nutrient impaired (PS or Non-PS pollution)		
Heavy metal impaired (PS or Non-PS pollution)		
Pesticides or trace organics impaired (PS or Non-PS pollution)		
Bacteria and pathogens impaired (PS or Non-PS pollution)		
Trash or refuse		
Comments		

11

BIOTIC STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Mowing, grazing, excessive herbivory (within AA)		
Excessive human visitation		
Predation and habitat destruction by non-native vertebrates (e.g., *Virginia opossum* and domestic predators, such as feral pets)		
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species		
Pesticide application or vector control		
Biological resource extraction or stocking (fisheries, aquaculture)		
Excessive organic debris in matrix (for vernal pools)		
Lack of vegetation management to conserve natural resources		
Lack of treatment of invasive plants adjacent to AA or buffer		
Comments		

BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (WITHIN 500 M OF AA)	Present	Significant negative effect on AA
Urban residential		
Industrial/commercial	y- active mining	
Military training/Air traffic		
Dams (or other major flow regulation or disruption)		
Dryland farming		
Intensive row-crop agriculture		
Orchards/nurseries		
Commercial feedlots		
Dairies		
Ranching (enclosed livestock grazing or horse paddock or feedlot)		
Transportation corridor		
Rangeland (livestock rangeland also managed for native vegetation)		
Sports fields and urban parklands (golf courses, soccer fields, etc.)		
Passive recreation (bird-watching, hiking, etc.)		
Active recreation (off-road vehicles, mountain biking, hunting, fishing)		
Physical resource extraction (rock, sediment, oil/gas)	y- active mining	
Biological resource extraction (aquaculture, commercial fisheries)		
Comments		

12

Basic Information Sheet: Riverine Wetlands

Assessment Area Name: RSW-001	
Project Name: Permanente Creek NPDES Study	
Assessment Area ID #: RSW-001	
Project ID #:	**Date:** 02/ 022 /2018
Assessment Team Members for This AA: Sarah Norris, Devin Barry	
Average Bankfull Width:	
Approximate Length of AA (10 times bankfull width, min 100 m, max 200 m)**:** 100 m	
Upstream Point Latitude: 37.31731552	**Longitude:** -122.1040505
Downstream Point Latitude: 37.3165554	**Longitude:** -122.10232332

Wetland Sub-type:

☐ Confined ☒ Non-confined

AA Category:

☐ Restoration ☐ Mitigation ☐ Impacted ☐ Ambient ☐ Reference ☐ Training

☒ Other: NPDES Documentation

Did the river/stream have flowing water at the time of the assessment? ☒ yes ☐ no

What is the apparent hydrologic flow regime of the reach you are assessing?

The hydrologic flow regime of a stream describes the frequency with which the channel conducts water. *Perennial* streams conduct water all year long, whereas *ephemeral* streams conduct water only during and immediately following precipitation events. *Intermittent* streams are dry for part of the year, but conduct water for periods longer than ephemeral streams, as a function of watershed size and water source.

☒ perennial ☐ intermittent ☐ ephemeral

1

Photo Identification Numbers and Description:

	Photo ID No.	Description	Latitude	Longitude	Datum
1		Upstream			
2		Middle Left			
3		Middle Right			
4		Downstream			
5					
6					
7					
8					
9					
10					

Site Location Description:

Comments:

2

Scoring Sheet: Riverine Wetlands

AA Name: RSW-001			**Date:** 2/02/2018	
Attribute 1: Buffer and Landscape Context (pp. 11-19)			**Comments**	
	Alpha.	Numeric		
Stream Corridor Continuity (D)	B	9		
Buffer:				
Buffer submetric A: Percent of AA with Buffer	B	9		
Buffer submetric B: Average Buffer Width	B	9		
Buffer submetric C: Buffer Condition	C	6		
Raw Attribute Score = D+[C x (A x B)^{½}]^{½}		16	**Final Attribute Score = (Raw Score/24) x 100**	66.7
Attribute 2: Hydrology (pp. 20-26)				
	Alpha.	Numeric		
Water Source	C	6		
Channel Stability	B	9		
Hydrologic Connectivity	B	9		
Raw Attribute Score = sum of numeric scores		24	**Final Attribute Score = (Raw Score/36) x 100**	66.7
Attribute 3: Physical Structure (pp. 27-33)				
	Alpha.	Numeric		
Structural Patch Richness	B	9	9 patch types	
Topographic Complexity	B	9	1 bench, complex microtopography	
Raw Attribute Score = sum of numeric scores		18	**Final Attribute Score = (Raw Score/24) x 100**	75
Attribute 4: Biotic Structure (pp. 34-41)				
Plant Community Composition (based on sub-metrics A-C)				
	Alpha.	Numeric		
Plant Community submetric A: Number of plant layers	A	12	4 layers (short, medium tall, very tall)	
Plant Community submetric B: Number of Co-dominant species	A	12		
Plant Community submetric C: Percent Invasion	B	9		
Plant Community Composition Metric *(numeric average of submetrics A-C)*		11		
Horizontal Interspersion	B	9		
Vertical Biotic Structure	B	9		
Raw Attribute Score = sum of numeric scores		29	**Final Attribute Score = (Raw Score/36) x 100**	80.5
Overall AA Score (average of four final Attribute Scores)				72.2

3

Worksheet for Stream Corridor Continuity Metric for Riverine Wetlands

Lengths of Non-buffer Segments For Distance of 500 m Upstream of AA		Lengths of Non-buffer Segments For Distance of 500 m Downstream of AA	
Segment No.	Length (m)	Segment No.	Length (m)
1		1	
2		2	
3		3	
4		4	
5		5	
Upstream Total Length	0	Downstream Total Length	166

Percent of AA with Buffer Worksheet

In the space provided below make a quick sketch of the AA, or perform the assessment directly on the aerial imagery; indicate where buffer is present, estimate the percentage of the AA perimeter providing buffer functions, and record the estimate amount in the space provided.

Percent of AA with Buffer: %

Worksheet for calculating average buffer width of AA

Line	Buffer Width (m)
A	250
B	250
C	250
D	250
E	65
F	79
G	80
H	54
Average Buffer Width *Round to the nearest integer*	160

Worksheet for Assessing Channel Stability for Riverine Wetlands

Condition	Field Indicators (check all existing conditions)
Indicators of Channel Equilibrium	☐ The channel (or multiple channels in braided systems) has a well-defined bankfull contour that clearly demarcates an obvious active floodplain in the cross-sectional profile of the channel throughout most of the AA. ☐ Perennial riparian vegetation is abundant and well established along the bankfull contour, but not below it. ☐ There is leaf litter, thatch, or wrack in most pools (if pools are present). ☐ The channel contains embedded woody debris of the size and amount consistent with what is naturally available in the riparian area. ☒ There is little or no active undercutting or burial of riparian vegetation. ☐ If mid-channel bars and/or point bars are present, they are not densely vegetated with perennial vegetation. ☐ Channel bars consist of well-sorted bed material (smaller grain size on the top and downstream end of the bar, larger grain size along the margins and upstream end of the bar). ☐ There are channel pools, the spacing between pools tends to be regular and the bed is not planar throughout the AA ☐ The larger bed material supports abundant mosses or periphyton.
Indicators of Active Degradation	☐ The channel is characterized by deeply undercut banks with exposed living roots of trees or shrubs. ☐ There are abundant bank slides or slumps. ☐ The lower banks are uniformly scoured and not vegetated. ☐ Riparian vegetation is declining in stature or vigor, or many riparian trees and shrubs along the banks are leaning or falling into the channel. ☐ An obvious historical floodplain has recently been abandoned, as indicated by the age structure of its riparian vegetation. ☐ The channel bed appears scoured to bedrock or dense clay. ☐ Recently active flow pathways appear to have coalesced into one channel (i.e. a previously braided system is no longer braided). ☐ The channel has one or more knickpoints indicating headward erosion of the bed.
Indicators of Active Aggradation	☒ There is an active floodplain with fresh splays of coarse sediment (sand and larger that is not vegetated) deposited in the current or previous year. ☐ There are partially buried living tree trunks or shrubs along the banks. ☒ The bed is planar (flat or uniform gradient) overall; it lacks well-defined channel pools, or they are uncommon and irregularly spaced. ☐ There are partially buried, or sediment-choked, culverts. ☐ Perennial terrestrial or riparian vegetation is encroaching into the channel or onto channel bars below the bankfull contour. ☐ There are avulsion channels on the floodplain or adjacent valley floor.
Overall	☐ **Equilibrium** ☐ **Degradation** ☐ **Aggradation**

5

Riverine Wetland Entrenchment Ratio Calculation Worksheet

The following 5 steps should be conducted for each of 3 cross-sections located in the AA at the approximate midpoints along straight riffles or glides, away from deep pools or meander bends. An attempt should be made to place them at the top, middle, and bottom of the AA.

Steps	Replicate Cross-sections ⟶	TOP	MID	BOT
1 Estimate bankfull width.	This is a critical step requiring familiarity with field indicators of the bankfull contour. Estimate or measure the distance between the right and left bankfull contours.	6'	12'	
2: Estimate max. bankfull depth.	Imagine a level line between the right and left bankfull contours; estimate or measure the height of the line above the thalweg (the deepest part of the channel).	18"	10"	
3: Estimate flood prone depth.	Double the estimate of maximum bankfull depth from Step 2.	36"	20"	
4: Estimate flood prone width.	Imagine a level line having a height equal to the flood prone depth from Step 3; note where the line intercepts the right and left banks; estimate or measure the length of this line.	60'	65'	
5: Calculate entrenchment ratio.	Divide the flood prone width (Step 4) by the bankfull width (Step 1).	10	5.4	
6: Calculate average entrenchment ratio.	Calculate the average results for Step 5 for all 3 replicate cross-sections. Enter the average result here and use it in Table 13a or 13b.			7.7

6

Structural Patch Type Worksheet for Riverine wetlands

Circle each type of patch that is observed in the AA and enter the total number of observed patches in Table below. In the case of riverine wetlands, their status as confined or non-confined must first be determined (see page 6) to determine with patches are expected in the system (indicated by a "1" in the table below). Any feature onsite should only be counted once as a patch type. If a feature appears to meet the definition of more than one patch type (i.e. swale and secondary channel) the practitioner should choose which patch type best illustrates the feature. Not all features at a site will be patch types.

Please refer to the CRAM Photo Dictionary at** www.cramwetlands.org **for photos of each of the following patch types.

STRUCTURAL PATCH TYPE (circle for presence)	**Riverine (Non-confined)**	**Riverine (Confined)**
Minimum Patch Size	**3 m^2**	**3 m^2**
Abundant wrackline or organic debris in channel, on floodplain	1	1
Bank slumps or undercut banks in channels or along shoreline	1	1
Cobbles and/or Boulders	1	1
Debris jams	1	1
Filamentous macroalgae or algal mats	1	1
Large woody debris	1	1
Pannes or pools on floodplain	1	N/A
Plant hummocks and/or sediment mounds	1	1
Point bars and in-channel bars	1	1
Pools or depressions in channels (wet or dry channels)	1	1
Riffles or rapids (wet or dry channels)	1	1
Secondary channels on floodplains or along shorelines	1	N/A
Standing snags (at least 3 m tall)	1	1
Submerged vegetation	1	N/A
Swales on floodplain or along shoreline	1	N/A
Variegated, convoluted, or crenulated foreshore (instead of broadly arcuate or mostly straight)	1	1
Vegetated islands (mostly above high-water)	1	N/A
Total Possible	**17**	**12**
No. Observed Patch Types (enter here and use in Table 14 below)	9	

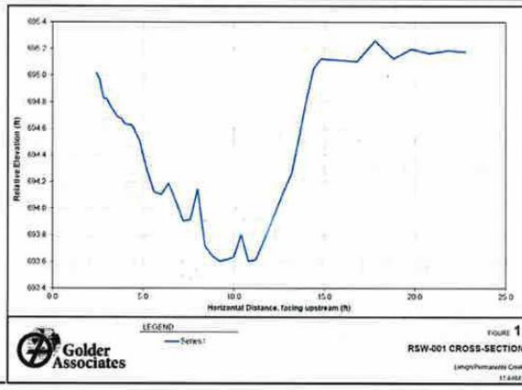
7

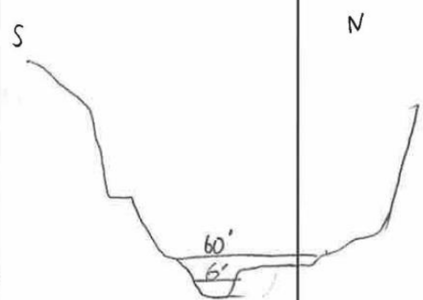
11" depth

Worksheet for AA Topographic Complexity

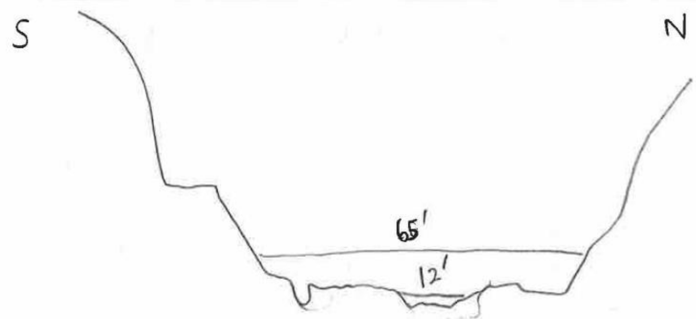
At three locations along the AA, make a sketch of the profile of the stream from the AA boundary down to its deepest area then back out to the other AA boundary. Try to capture the benches and the intervening micro-topographic relief. To maintain consistency, make drawings at each of the stream hydrologic connectivity measurements, always facing downstream. Include the water level, an arrow at the bankfull contour, and label the benches. Based on these sketches and the profiles in Figure 10, choose a description in Table 16 that best describes the overall topographic complexity of the AA.

Profile 1

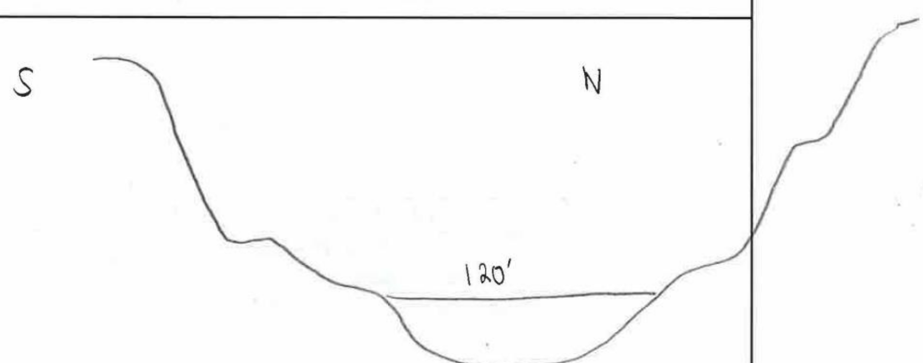




Profile 2



Profile 3



Plant Community Metric Worksheet: Co-dominant species richness for Riverine wetlands
(A dominant species represents ≥10% *relative* cover)

Special Note:

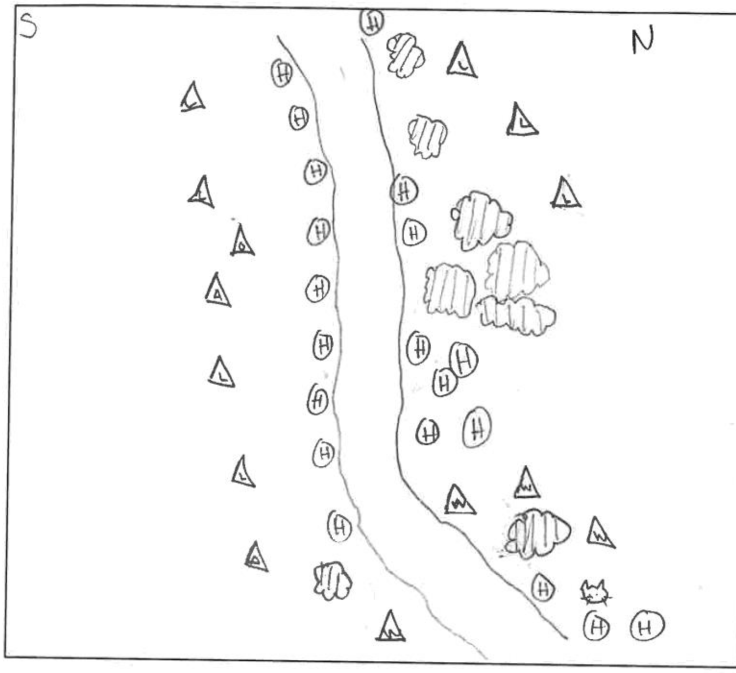
* *Combine the counts of co-dominant species from all layers to identify the total species count. Each plant species is only counted once when calculating the Number of Co-dominant Species and Percent Invasion submetric scores, regardless of the numbers of layers in which it occurs.*

Floating or Canopy-forming (non-confined only)	Invasive?	Short (<0.5 m)	Invasive?
		Urtica dioica	
		Brassica nigra	y
		Equisetum arvense	
		Rorippa nasturtium-aquaticum	
		Silybum marianum	y
		Carduus pycnocephalus	y
Medium (0.5-1.5 m)	**Invasive?**	**Tall (1.5-3.0 m)**	**Invasive?**
Urtica dioica		Baccharis pilularis	
Typha angustifolia			
Baccharis pilularis			
Very Tall (>3.0 m)	**Invasive?**	Total number of co-dominant species for all layers combined (enter here and use in Table 18)	12
Salix lasiolepis			
Quercus agrifolia			
Umbellularia californica		Percent Invasion *Round to the nearest integer* (enter here and use in Table 18)	25%
Salix gooddingii			

9

Horizontal Interspersion Worksheet.

Use the spaces below to make a quick sketch of the AA in plan view, outlining the major plant zones (this should take no longer than 10 minutes). Assign the zones names and record them on the right. Based on the sketch, choose a single profile from Figure 12 that best represents the AA overall.



Assigned zones:

1) Shrub

2) Herb.

3) trees

4) Cattail

5)

6)

Worksheet for Wetland disturbances and conversions

Has a major disturbance occurred at this wetland?	Yes	No		
If yes, was it a flood, fire, landslide, or other?	flood	fire	landslide	other
If yes, then how severe is the disturbance?	likely to affect site next 5 or more years	likely to affect site next 3-5 years	likely to affect site next 1-2 years	
Has this wetland been converted from another type? If yes, then what was the previous type?	depressional	vernal pool	vernal pool system	
	non-confined riverine	confined riverine	seasonal estuarine	
	perennial saline estuarine	perennial non-saline estuarine	wet meadow	
	lacustrine	seep or spring	playa	

Stressor Checklist Worksheet

HYDROLOGY ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Point Source (PS) discharges (POTW, other non-stormwater discharge)	y	
Non-point Source (Non-PS) discharges (urban runoff, farm drainage)		
Flow diversions or unnatural inflows	y	
Dams (reservoirs, detention basins, recharge basins)		
Flow obstructions (culverts, paved stream crossings)	y	
Weir/drop structure, tide gates	y	
Dredged inlet/channel		
Engineered channel (riprap, armored channel bank, bed)		
Dike/levees		
Groundwater extraction		
Ditches (borrow, agricultural drainage, mosquito control, etc.)		
Actively managed hydrology	y	
Comments		
Culvert outfall at end of AA; weir/artifical pond at end of AA		

PHYSICAL STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Filling or dumping of sediment or soils **(N/A for restoration areas)**		
Grading/ compaction **(N/A for restoration areas)**		
Plowing/Discing **(N/A for restoration areas)**		
Resource extraction (sediment, gravel, oil and/or gas)		
Vegetation management		
Excessive sediment or organic debris from watershed	y- netting to prevent slope failure along S-bank.	
Excessive runoff from watershed		
Nutrient impaired (PS or Non-PS pollution)		
Heavy metal impaired (PS or Non-PS pollution)		
Pesticides or trace organics impaired (PS or Non-PS pollution)		
Bacteria and pathogens impaired (PS or Non-PS pollution)		
Trash or refuse		
Comments		

BIOTIC STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Mowing, grazing, excessive herbivory (within AA)		
Excessive human visitation		
Predation and habitat destruction by non-native vertebrates (e.g., *Virginia opossum* and domestic predators, such as feral pets)		
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species		
Pesticide application or vector control		
Biological resource extraction or stocking (fisheries, aquaculture)		
Excessive organic debris in matrix (for vernal pools)		
Lack of vegetation management to conserve natural resources		
Lack of treatment of invasive plants adjacent to AA or buffer		
Comments		

BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (WITHIN 500 M OF AA)	Present	Significant negative effect on AA
Urban residential		
Industrial/commercial	y- mining	
Military training/Air traffic		
Dams (or other major flow regulation or disruption)	y- weir	
Dryland farming		
Intensive row-crop agriculture		
Orchards/nurseries		
Commercial feedlots		
Dairies		
Ranching (enclosed livestock grazing or horse paddock or feedlot)		
Transportation corridor		
Rangeland (livestock rangeland also managed for native vegetation)		
Sports fields and urban parklands (golf courses, soccer fields, etc.)		
Passive recreation (bird-watching, hiking, etc.)		
Active recreation (off-road vehicles, mountain biking, hunting, fishing)		
Physical resource extraction (rock, sediment, oil/gas)	y- mining	
Biological resource extraction (aquaculture, commercial fisheries)		
Comments		

12

Basic Information Sheet: Riverine Wetlands

Assessment Area Name: RSW-002	
Project Name: Permanente Creek NPDES Study	
Assessment Area ID #: RSW-002	
Project ID #:	**Date:** 02/ 02 /2018
Assessment Team Members for This AA: Sarah Norris, Devin Barry	
Average Bankfull Width:	
Approximate Length of AA (10 times bankfull width, min 100 m, max 200 m)**:** 100 m	
Upstream Point Latitude: 37.31596124	**Longitude:** -122.0992697
Downstream Point Latitude: 37.31465660	**Longitude:** -122.0978000

Wetland Sub-type:

☒ Confined ☐ Non-confined

AA Category:

☐ Restoration ☐ Mitigation ☐ Impacted ☐ Ambient ☐ Reference ☐ Training

☒ Other: NPDES Documentation

Did the river/stream have flowing water at the time of the assessment? ☒ yes ☐ no

Most of AA lacks water, stream is losing water and goes dry downstream of monitoring location.

What is the apparent hydrologic flow regime of the reach you are assessing?

The hydrologic flow regime of a stream describes the frequency with which the channel conducts water. *Perennial* streams conduct water all year long, whereas *ephemeral* streams conduct water only during and immediately following precipitation events. *Intermittent* streams are dry for part of the year, but conduct water for periods longer than ephemeral streams, as a function of watershed size and water source.

☐ perennial ☒ intermittent ☐ ephemeral

1

Photo Identification Numbers and Description:

	Photo ID No.	Description	Latitude	Longitude	Datum
1		Upstream			
2		Middle Left			
3		Middle Right			
4		Downstream			
5					
6					
7					
8					
9					
10					

Site Location Description:

Comments:

Scoring Sheet: Riverine Wetlands

AA Name: RSW-002					Date: 2/ 02/2018	
Attribute 1: Buffer and Landscape Context (pp. 11-19)					**Comments**	
Stream Corridor Continuity (D)			Alpha. B	Numeric 9		
Buffer:						
Buffer submetric A: Percent of AA with Buffer	Alpha. B	Numeric 9				
Buffer submetric B: Average Buffer Width	C	6				
Buffer submetric C: Buffer Condition	C	6				
Raw Attribute Score = D+[C x (A x B)^{½}]^{½}				15.6	**Final Attribute Score = (Raw Score/24) x 100**	65
Attribute 2: Hydrology (pp. 20-26)						
Water Source			Alpha. C	Numeric 6		
Channel Stability			B	9		
Hydrologic Connectivity			A	12	Entrench ratio 1.9	
Raw Attribute Score = sum of numeric scores				27	**Final Attribute Score = (Raw Score/36) x 100**	75
Attribute 3: Physical Structure (pp. 27-33)						
Structural Patch Richness			Alpha. A	Numeric 12		
Topographic Complexity			B	9		
Raw Attribute Score = sum of numeric scores				21	**Final Attribute Score = (Raw Score/24) x 100**	87.5
Attribute 4: Biotic Structure (pp. 34-41)						
Plant Community Composition (based on sub-metrics A-C)						
Plant Community submetric A: Number of plant layers	Alpha. B	Numeric 9			3 layers (short, tall, very tall)	
Plant Community submetric B: Number of Co-dominant species	A	12			13 co-dom species	
Plant Community submetric C: Percent Invasion	A	12				
Plant Community Composition Metric *(numeric average of submetrics A-C)*				11		
Horizontal Interspersion			C	6		
Vertical Biotic Structure			B	9		
Raw Attribute Score = sum of numeric scores				26	**Final Attribute Score = (Raw Score/36) x 100**	72.2
Overall AA Score (average of four final Attribute Scores)					74.9	

3

Worksheet for Stream Corridor Continuity Metric for Riverine Wetlands

Lengths of Non-buffer Segments For Distance of 500 m Upstream of AA		Lengths of Non-buffer Segments For Distance of 500 m Downstream of AA	
Segment No.	Length (m)	Segment No.	Length (m)
1		1	
2		2	
3		3	
4		4	
5		5	
Upstream Total Length	166	Downstream Total Length	31

Percent of AA with Buffer Worksheet

In the space provided below make a quick sketch of the AA, or perform the assessment directly on the aerial imagery; indicate where buffer is present, estimate the percentage of the AA perimeter providing buffer functions, and record the estimate amount in the space provided.

Percent of AA with Buffer: ______ %

Worksheet for calculating average buffer width of AA

Line	Buffer Width (m)
A	250
B	250
C	250
D	250
E	7
F	10
G	6
H	8
Average Buffer Width *Round to the nearest integer*	130

Worksheet for Assessing Channel Stability for Riverine Wetlands

Condition	Field Indicators (check all existing conditions)
Indicators of Channel Equilibrium	☐ The channel (or multiple channels in braided systems) has a well-defined bankfull contour that clearly demarcates an obvious active floodplain in the cross-sectional profile of the channel throughout most of the AA. ☐ Perennial riparian vegetation is abundant and well established along the bankfull contour, but not below it. ☐ There is leaf litter, thatch, or wrack in most pools (if pools are present). ☐ The channel contains embedded woody debris of the size and amount consistent with what is naturally available in the riparian area. ☐ There is little or no active undercutting or burial of riparian vegetation. ☐ If mid-channel bars and/or point bars are present, they are not densely vegetated with perennial vegetation. ☐ Channel bars consist of well-sorted bed material (smaller grain size on the top and downstream end of the bar, larger grain size along the margins and upstream end of the bar). ☐ There are channel pools, the spacing between pools tends to be regular and the bed is not planar throughout the AA ☐ The larger bed material supports abundant mosses or periphyton.
Indicators of Active Degradation	☐ The channel is characterized by deeply undercut banks with exposed living roots of trees or shrubs. ☒ There are abundant bank slides or slumps. ☐ The lower banks are uniformly scoured and not vegetated. ☒ Riparian vegetation is declining in stature or vigor, or many riparian trees and shrubs along the banks are leaning or falling into the channel. ☐ An obvious historical floodplain has recently been abandoned, as indicated by the age structure of its riparian vegetation. ☐ The channel bed appears scoured to bedrock or dense clay. ☐ Recently active flow pathways appear to have coalesced into one channel (i.e. a previously braided system is no longer braided). ☐ The channel has one or more knickpoints indicating headward erosion of the bed.
Indicators of Active Aggradation	☐ There is an active floodplain with fresh splays of coarse sediment (sand and larger that is not vegetated) deposited in the current or previous year. ☐ There are partially buried living tree trunks or shrubs along the banks. ☒ The bed is planar (flat or uniform gradient) overall; it lacks well-defined channel pools, or they are uncommon and irregularly spaced. ☐ There are partially buried, or sediment-choked, culverts. ☒ Perennial terrestrial or riparian vegetation is encroaching into the channel or onto channel bars below the bankfull contour. ☐ There are avulsion channels on the floodplain or adjacent valley floor.
Overall	☐ **Equilibrium** ☐ **Degradation** ☐ **Aggradation**

Riverine Wetland Entrenchment Ratio Calculation Worksheet

The following 5 steps should be conducted for each of 3 cross-sections located in the AA at the approximate midpoints along straight riffles or glides, away from deep pools or meander bends. An attempt should be made to place them at the top, middle, and bottom of the AA.				
Steps	**Replicate Cross-sections →**	**TOP**	**MID**	**BOT**
1 Estimate bankfull width.	This is a critical step requiring familiarity with field indicators of the bankfull contour. Estimate or measure the distance between the right and left bankfull contours.	10'	10'	10'
2: Estimate max. bankfull depth.	Imagine a level line between the right and left bankfull contours; estimate or measure the height of the line above the thalweg (the deepest part of the channel).	10"	10"	10"
3: Estimate flood prone depth.	Double the estimate of maximum bankfull depth from Step 2.	20"	20"	20"
4: Estimate flood prone width.	Imagine a level line having a height equal to the flood prone depth from Step 3; note where the line intercepts the right and left banks; estimate or measure the length of this line.	15'	18'	25'
5: Calculate entrenchment ratio.	Divide the flood prone width (Step 4) by the bankfull width (Step 1).	1.5	1.8	2.5
6: Calculate average entrenchment ratio.	Calculate the average results for Step 5 for all 3 replicate cross-sections. Enter the average result here and use it in Table 13a or 13b.			1.9

Structural Patch Type Worksheet for Riverine wetlands

Circle each type of patch that is observed in the AA and enter the total number of observed patches in Table below. In the case of riverine wetlands, their status as confined or non-confined must first be determined (see page 6) to determine with patches are expected in the system (indicated by a "1" in the table below). Any feature onsite should only be counted once as a patch type. If a feature appears to meet the definition of more than one patch type (i.e. swale and secondary channel) the practitioner should choose which patch type best illustrates the feature. Not all features at a site will be patch types.

**Please refer to the CRAM Photo Dictionary at www.cramwetlands.org for photos of each of the following patch types.*

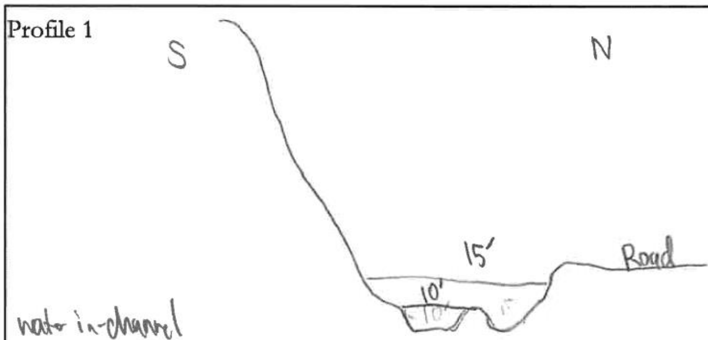
STRUCTURAL PATCH TYPE (circle for presence)	Riverine (Non-confined)	Riverine (Confined)
Minimum Patch Size	**3 m^2**	**3 m^2**
Abundant wrackline or organic debris in channel, on floodplain	1	1
Bank slumps or undercut banks in channels or along shoreline	1	1
Cobbles and/or Boulders	1	1
Debris jams	1	1
Filamentous macroalgae or algal mats	1	1
Large woody debris	1	1
Pannes or pools on floodplain	1	N/A
Plant hummocks and/or sediment mounds	1	1
Point bars and in-channel bars	1	1
Pools or depressions in channels (wet or dry channels)	1	1
Riffles or rapids (wet or dry channels)	1	1
Secondary channels on floodplains or along shorelines	1	N/A
Standing snags (at least 3 m tall)	1	1
Submerged vegetation	1	N/A
Swales on floodplain or along shoreline	1	N/A
Variegated, convoluted, or crenulated foreshore (instead of broadly arcuate or mostly straight)	1	1
Vegetated islands (mostly above high-water)	1	N/A
Total Possible	**17**	**12**
No. Observed Patch Types (enter here and use in Table 14 below)		8

7

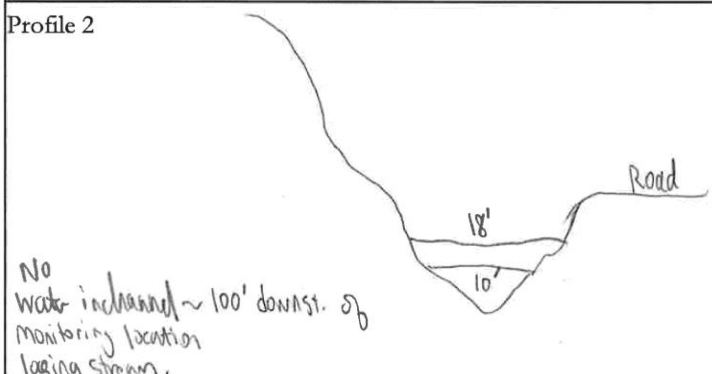
Worksheet for AA Topographic Complexity

At three locations along the AA, make a sketch of the profile of the stream from the AA boundary down to its deepest area then back out to the other AA boundary. Try to capture the benches and the intervening micro-topographic relief. To maintain consistency, make drawings at each of the stream hydrologic connectivity measurements, always facing downstream. Include the water level, an arrow at the bankfull contour, and label the benches. Based on these sketches and the profiles in Figure 10, choose a description in Table 16 that best describes the overall topographic complexity of the AA.

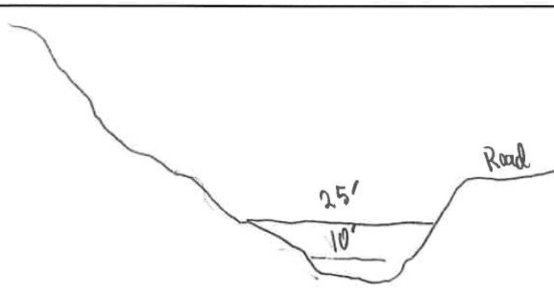
Profile 1



Profile 2



Profile 3



8

Plant Community Metric Worksheet: Co-dominant species richness for Riverine wetlands
(A dominant species represents ≥10% *relative* cover)

Special Note:

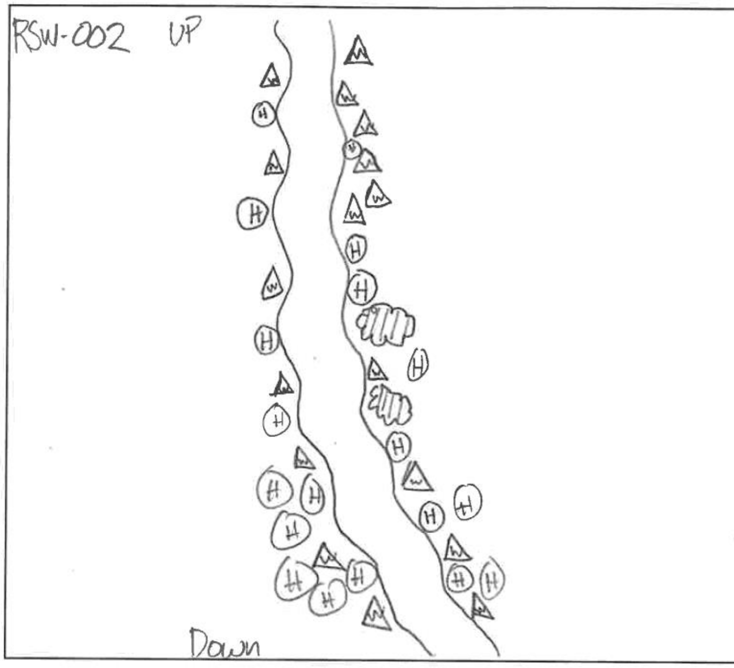
* *Combine the counts of co-dominant species from all layers to identify the total species count. Each plant species is only counted once when calculating the Number of Co-dominant Species and Percent Invasion submetric scores, regardless of the numbers of layers in which it occurs.*

Floating or Canopy-forming (non-confined only)	Invasive?	Short (<0.5 m)	Invasive?
		Urtica dioica	
		Rubus ursinus	
		Cyperus eragrostis	
		Torilis arvensis	
		Adiantum jordanii	
		Stellaria media	
Medium (0.5-1.5 m)	**Invasive?**	**Tall (1.5-3.0 m)**	**Invasive?**
		Salix lasiandra	
		Sambucus nigra	
		Salix lasiolepis	
Very Tall (>3.0 m)	**Invasive?**	**Total number of co-dominant species for all layers combined (enter here and use in Table 18)**	13
Salix gooddingii			
Alnus rhombifolia			
Quercus agrifolia		**Percent Invasion *Round to the nearest integer* (enter here and use in Table 18)**	0
Umbellularia californica			

9

Horizontal Interspersion Worksheet.

Use the spaces below to make a quick sketch of the AA in plan view, outlining the major plant zones (this should take no longer than 10 minutes). Assign the zones names and record them on the right. Based on the sketch, choose a single profile from Figure 12 that best represents the AA overall.



Assigned zones:

1) Trees

2) Herbs

3) Shrub

4)

5)

6)

Worksheet for Wetland disturbances and conversions

Has a major disturbance occurred at this wetland?	Yes	No		
If yes, was it a flood, fire, landslide, or other?	flood	fire	landslide	other
If yes, then how severe is the disturbance?	likely to affect site next 5 or more years	likely to affect site next 3-5 years	likely to affect site next 1-2 years	
Has this wetland been converted from another type? If yes, then what was the previous type?	depressional	vernal pool	vernal pool system	
	non-confined riverine	confined riverine	seasonal estuarine	
	perennial saline estuarine	perennial non-saline estuarine	wet meadow	
	lacustrine	seep or spring	playa	

10

Stressor Checklist Worksheet

HYDROLOGY ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Point Source (PS) discharges (POTW, other non-stormwater discharge)	y	
Non-point Source (Non-PS) discharges (urban runoff, farm drainage)		
Flow diversions or unnatural inflows		
Dams (reservoirs, detention basins, recharge basins)		
Flow obstructions (culverts, paved stream crossings)		
Weir/drop structure, tide gates		
Dredged inlet/channel		
Engineered channel (riprap, armored channel bank, bed)		
Dike/levees		
Groundwater extraction		
Ditches (borrow, agricultural drainage, mosquito control, etc.)		
Actively managed hydrology	y	
Comments		
Sedimentation basins located north of adjacent road at base of hillslope		

PHYSICAL STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Filling or dumping of sediment or soils **(N/A for restoration areas)**		
Grading/ compaction **(N/A for restoration areas)**	y- adjacent road	
Plowing/Discing **(N/A for restoration areas)**		
Resource extraction (sediment, gravel, oil and/or gas)		
Vegetation management		
Excessive sediment or organic debris from watershed		
Excessive runoff from watershed		
Nutrient impaired (PS or Non-PS pollution)		
Heavy metal impaired (PS or Non-PS pollution)		
Pesticides or trace organics impaired (PS or Non-PS pollution)		
Bacteria and pathogens impaired (PS or Non-PS pollution)		
Trash or refuse		
Comments		

11

BIOTIC STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Mowing, grazing, excessive herbivory (within AA)		
Excessive human visitation		
Predation and habitat destruction by non-native vertebrates (e.g., *Virginia opossum* and domestic predators, such as feral pets)		
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species		
Pesticide application or vector control		
Biological resource extraction or stocking (fisheries, aquaculture)		
Excessive organic debris in matrix (for vernal pools)		
Lack of vegetation management to conserve natural resources		
Lack of treatment of invasive plants adjacent to AA or buffer		
Comments		

BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (WITHIN 500 M OF AA)	Present	Significant negative effect on AA
Urban residential		
Industrial/commercial	y- active mining	
Military training/Air traffic		
Dams (or other major flow regulation or disruption)		
Dryland farming		
Intensive row-crop agriculture		
Orchards/nurseries		
Commercial feedlots		
Dairies		
Ranching (enclosed livestock grazing or horse paddock or feedlot)		
Transportation corridor		
Rangeland (livestock rangeland also managed for native vegetation)		
Sports fields and urban parklands (golf courses, soccer fields, etc.)		
Passive recreation (bird-watching, hiking, etc.)		
Active recreation (off-road vehicles, mountain biking, hunting, fishing)		
Physical resource extraction (rock, sediment, oil/gas)	y- active mining	
Biological resource extraction (aquaculture, commercial fisheries)		
Comments		

12

Basic Information Sheet: Riverine Wetlands

Assessment Area Name:	RSW-003		
Project Name:	Permanente Creek NPDES Study		
Assessment Area ID #:	RSW-003		
Project ID #:		**Date:**	02/ 02 /2018
Assessment Team Members for This AA:	Sarah Norris, Devin Barry		
Average Bankfull Width:			
Approximate Length of AA (10 times bankfull width, min 100 m, max 200 m)**:**	100 m		
Upstream Point Latitude:	37.31294751	**Longitude:**	-122.0911395
Downstream Point Latitude:	37.31421040	**Longitude:**	-122.08999687

Wetland Sub-type:

☒ Confined ☐ Non-confined

AA Category:

☐ Restoration ☐ Mitigation ☐ Impacted ☐ Ambient ☐ Reference ☐ Training

☒ Other: NPDES Documentation

Did the river/stream have flowing water at the time of the assessment? ☒ yes ☐ no

What is the apparent hydrologic flow regime of the reach you are assessing?

The hydrologic flow regime of a stream describes the frequency with which the channel conducts water. *Perennial* streams conduct water all year long, whereas *ephemeral* streams conduct water only during and immediately following precipitation events. *Intermittent* streams are dry for part of the year, but conduct water for periods longer than ephemeral streams, as a function of watershed size and water source.

☒ perennial ☐ intermittent ☐ ephemeral

1

Photo Identification Numbers and Description:

	Photo ID No.	Description	Latitude	Longitude	Datum
1		Upstream			
2		Middle Left			
3		Middle Right			
4		Downstream			
5					
6					
7					
8					
9					
10					

Site Location Description:

Comments:

2

Scoring Sheet: Riverine Wetlands

AA Name: RSW-003				**Date:** 2/02/2018
Attribute 1: Buffer and Landscape Context (pp. 11-19)				**Comments**
		Alpha.	Numeric	
Stream Corridor Continuity (D)		B	9	
Buffer:				
	Alpha. / Numeric			
Buffer submetric A: Percent of AA with Buffer	B / 9			
Buffer submetric B: Average Buffer Width	D / 3			
Buffer submetric C: Buffer Condition	C / 6			
Raw Attribute Score = D+[C x (A x B)^{½}]^{½}			14.5	**Final Attribute Score = (Raw Score/24) x 100** 60.4
Attribute 2: Hydrology (pp. 20-26)				
		Alpha.	Numeric	
Water Source		C	6	
Channel Stability		B	9	
Hydrologic Connectivity		A	12	Entrench ratio 2.3
Raw Attribute Score = sum of numeric scores			27	**Final Attribute Score = (Raw Score/36) x 100** 75
Attribute 3: Physical Structure (pp. 27-33)				
		Alpha.	Numeric	
Structural Patch Richness		A	12	9 patches
Topographic Complexity		B	9	
Raw Attribute Score = sum of numeric scores			21	**Final Attribute Score = (Raw Score/24) x 100** 87.5
Attribute 4: Biotic Structure (pp. 34-41)				
Plant Community Composition (based on sub-metrics A-C)				
	Alpha. / Numeric			
Plant Community submetric A: Number of plant layers	B / 9			3 layers (short, medium, very tall)
Plant Community submetric B: Number of Co-dominant species	B / 9			10 co-dom species
Plant Community submetric C: Percent Invasion	A / 12			
Plant Community Composition Metric *(numeric average of submetrics A-C)*			10	
Horizontal Interspersion		C	6	
Vertical Biotic Structure		B	9	
Raw Attribute Score = sum of numeric scores			25	**Final Attribute Score = (Raw Score/36) x 100** 69.4
Overall AA Score (average of four final Attribute Scores)				73.0

3

Worksheet for Stream Corridor Continuity Metric for Riverine Wetlands

Lengths of Non-buffer Segments For Distance of 500 m Upstream of AA		Lengths of Non-buffer Segments For Distance of 500 m Downstream of AA	
Segment No.	Length (m)	Segment No.	Length (m)
1		1	
2		2	
3		3	
4		4	
5		5	
Upstream Total Length	31	Downstream Total Length	177

Percent of AA with Buffer Worksheet

In the space provided below make a quick sketch of the AA, or perform the assessment directly on the aerial imagery; indicate where buffer is present, estimate the percentage of the AA perimeter providing buffer functions, and record the estimate amount in the space provided.

Percent of AA with Buffer: ______ %

Worksheet for calculating average buffer width of AA

Line	Buffer Width (m)
A	15
B	12
C	9
D	11
E	71
F	58
G	47
H	39
Average Buffer Width *Round to the nearest integer*	33

4

Worksheet for Assessing Channel Stability for Riverine Wetlands

Condition	Field Indicators (check all existing conditions)
Indicators of Channel Equilibrium	☒ The channel (or multiple channels in braided systems) has a well-defined bankfull contour that clearly demarcates an obvious active floodplain in the cross-sectional profile of the channel throughout most of the AA. ☒ Perennial riparian vegetation is abundant and well established along the bankfull contour, but not below it. ☐ There is leaf litter, thatch, or wrack in most pools (if pools are present). ☐ The channel contains embedded woody debris of the size and amount consistent with what is naturally available in the riparian area. ☐ There is little or no active undercutting or burial of riparian vegetation. ☐ If mid-channel bars and/or point bars are present, they are not densely vegetated with perennial vegetation. ☐ Channel bars consist of well-sorted bed material (smaller grain size on the top and downstream end of the bar, larger grain size along the margins and upstream end of the bar). ☐ There are channel pools, the spacing between pools tends to be regular and the bed is not planar throughout the AA ☐ The larger bed material supports abundant mosses or periphyton.
Indicators of Active Degradation	☐ The channel is characterized by deeply undercut banks with exposed living roots of trees or shrubs. ☐ There are abundant bank slides or slumps. ☒ The lower banks are uniformly scoured and not vegetated. ☐ Riparian vegetation is declining in stature or vigor, or many riparian trees and shrubs along the banks are leaning or falling into the channel. ☐ An obvious historical floodplain has recently been abandoned, as indicated by the age structure of its riparian vegetation. ☐ The channel bed appears scoured to bedrock or dense clay. ☐ Recently active flow pathways appear to have coalesced into one channel (i.e. a previously braided system is no longer braided). ☐ The channel has one or more knickpoints indicating headward erosion of the bed.
Indicators of Active Aggradation	☐ There is an active floodplain with fresh splays of coarse sediment (sand and larger that is not vegetated) deposited in the current or previous year. ☐ There are partially buried living tree trunks or shrubs along the banks. ☐ The bed is planar (flat or uniform gradient) overall; it lacks well-defined channel pools, or they are uncommon and irregularly spaced. ☐ There are partially buried, or sediment-choked, culverts. ☐ Perennial terrestrial or riparian vegetation is encroaching into the channel or onto channel bars below the bankfull contour. ☐ There are avulsion channels on the floodplain or adjacent valley floor.
Overall	☒ **Equilibrium** ☐ **Degradation** ☐ **Aggradation**

5

Riverine Wetland Entrenchment Ratio Calculation Worksheet

<table>
<tr><td colspan="5">The following 5 steps should be conducted for each of 3 cross-sections located in the AA at the approximate midpoints along straight riffles or glides, away from deep pools or meander bends. An attempt should be made to place them at the top, middle, and bottom of the AA.</td></tr>
<tr><th>Steps</th><th>Replicate Cross-sections →</th><th>TOP</th><th>MID</th><th>BOT</th></tr>
<tr><td>1 Estimate bankfull width.</td><td>This is a critical step requiring familiarity with field indicators of the bankfull contour. Estimate or measure the distance between the right and left bankfull contours.</td><td>9'</td><td></td><td>8'</td></tr>
<tr><td>2: Estimate max. bankfull depth.</td><td>Imagine a level line between the right and left bankfull contours; estimate or measure the height of the line above the thalweg (the deepest part of the channel).</td><td>18"</td><td></td><td>16"</td></tr>
<tr><td>3: Estimate flood prone depth.</td><td>Double the estimate of maximum bankfull depth from Step 2.</td><td>36"</td><td></td><td>32"</td></tr>
<tr><td>4: Estimate flood prone width.</td><td>Imagine a level line having a height equal to the flood prone depth from Step 3; note where the line intercepts the right and left banks; estimate or measure the length of this line.</td><td>15'</td><td></td><td>25'</td></tr>
<tr><td>5: Calculate entrenchment ratio.</td><td>Divide the flood prone width (Step 4) by the bankfull width (Step 1).</td><td>1.6</td><td></td><td>3.1</td></tr>
<tr><td>6: Calculate average entrenchment ratio.</td><td colspan="3">Calculate the average results for Step 5 for all 3 replicate cross-sections. Enter the average result here and use it in Table 13a or 13b.</td><td>2.3</td></tr>
</table>

Structural Patch Type Worksheet for Riverine wetlands

Circle each type of patch that is observed in the AA and enter the total number of observed patches in Table below. In the case of riverine wetlands, their status as confined or non-confined must first be determined (see page 6) to determine with patches are expected in the system (indicated by a "1" in the table below). Any feature onsite should only be counted once as a patch type. If a feature appears to meet the definition of more than one patch type (i.e. swale and secondary channel) the practitioner should choose which patch type best illustrates the feature. Not all features at a site will be patch types.

Please refer to the CRAM Photo Dictionary at** www.cramwetlands.org **for photos of each of the following patch types.

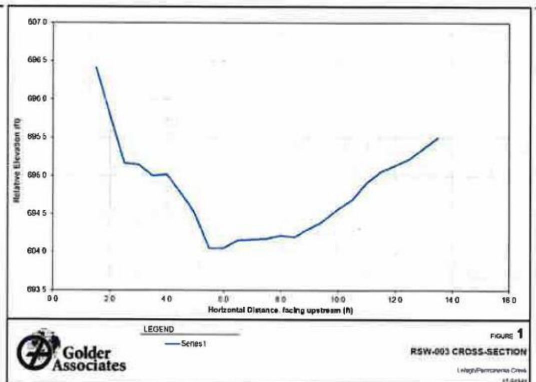
STRUCTURAL PATCH TYPE (circle for presence)	Riverine (Non-confined)	Riverine (Confined)
Minimum Patch Size	**3 m²**	**3 m²**
Abundant wrackline or organic debris in channel, on floodplain	1	1
Bank slumps or undercut banks in channels or along shoreline	1	1
Cobbles and/or Boulders	1	1
Debris jams	1	1
Filamentous macroalgae or algal mats	1	1
Large woody debris	1	1
Pannes or pools on floodplain	1	N/A
Plant hummocks and/or sediment mounds	1	1
Point bars and in-channel bars	1	1
Pools or depressions in channels (wet or dry channels)	1	1
Riffles or rapids (wet or dry channels)	1	1
Secondary channels on floodplains or along shorelines	1	N/A
Standing snags (at least 3 m tall)	1	1
Submerged vegetation	1	N/A
Swales on floodplain or along shoreline	1	N/A
Variegated, convoluted, or crenulated foreshore (instead of broadly arcuate or mostly straight)	1	1
Vegetated islands (mostly above high-water)	1	N/A
Total Possible	**17**	**12**
No. Observed Patch Types (enter here and use in Table 14 below)		9

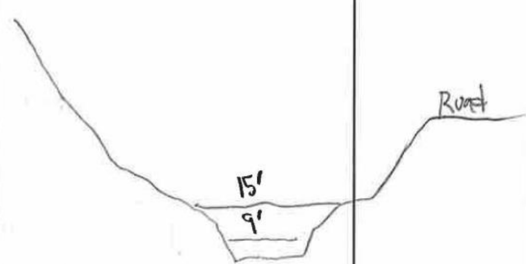
7

Worksheet for AA Topographic Complexity

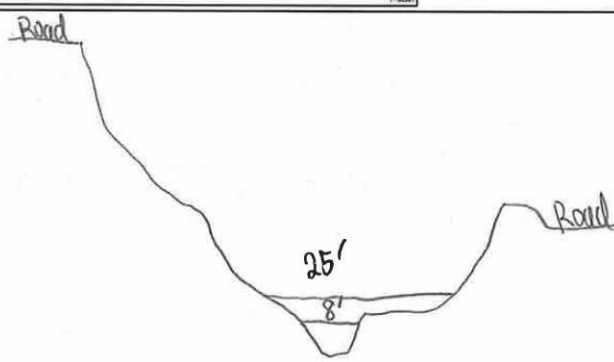
At three locations along the AA, make a sketch of the profile of the stream from the AA boundary down to its deepest area then back out to the other AA boundary. Try to capture the benches and the intervening micro-topographic relief. To maintain consistency, make drawings at each of the stream hydrologic connectivity measurements, always facing downstream. Include the water level, an arrow at the bankfull contour, and label the benches. Based on these sketches and the profiles in Figure 10, choose a description in Table 16 that best describes the overall topographic complexity of the AA.

Profile 1





Profile 2



Profile 3

8

Plant Community Metric Worksheet: Co-dominant species richness for Riverine wetlands
(A dominant species represents ≥10% *relative* cover)

Special Note:

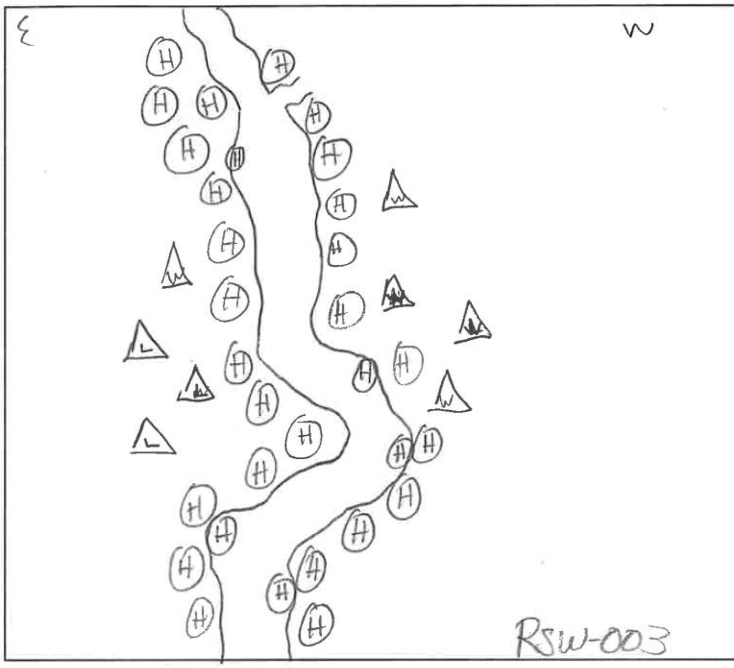
* *Combine the counts of co-dominant species from all layers to identify the total species count. Each plant species is only counted once when calculating the Number of Co-dominant Species and Percent Invasion submetric scores, regardless of the numbers of layers in which it occurs.*

Floating or Canopy-forming (non-confined only)	Invasive?	Short (<0.5 m)	Invasive?
		Rorippa nasturtium-aquaticum	
		Rubus ursinus	
		Urtica dioica	
Medium (0.5-1.5 m)	**Invasive?**	**Tall (1.5-3.0 m)**	**Invasive?**
Urtica dioica			
Rubus ursinus			
Salix lasiolepis			
Very Tall (>3.0 m)	**Invasive?**	Total number of co-dominant species for all layers combined (enter here and use in Table 18)	10
Umbellularia californica			
Salix gooddingii			
Vitis californica		Percent Invasion *Round to the nearest integer* (enter here and use in Table 18)	0
Quercus agrifolia			
Alnus rhombifolia			

9

Horizontal Interspersion Worksheet.

Use the spaces below to make a quick sketch of the AA in plan view, outlining the major plant zones (this should take no longer than 10 minutes). Assign the zones names and record them on the right. Based on the sketch, choose a single profile from Figure 12 that best represents the AA overall.

	**Assigned zones:** **1)** H Herb **2)** Tree **3)** **4)** **5)** **6)**

Worksheet for Wetland disturbances and conversions

Has a major disturbance occurred at this wetland?	Yes	No		
If yes, was it a flood, fire, landslide, or other?	flood	fire	landslide	other
If yes, then how severe is the disturbance?	likely to affect site next 5 or more years	likely to affect site next 3-5 years	likely to affect site next 1-2 years	
Has this wetland been converted from another type? If yes, then what was the previous type?	depressional	vernal pool	vernal pool system	
	non-confined riverine	confined riverine	seasonal estuarine	
	perennial saline estuarine	perennial non-saline estuarine	wet meadow	
	lacustrine	seep or spring	playa	

Stressor Checklist Worksheet

HYDROLOGY ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Point Source (PS) discharges (POTW, other non-stormwater discharge)	y- culvert outfall at top of AA	
Non-point Source (Non-PS) discharges (urban runoff, farm drainage)		
Flow diversions or unnatural inflows		
Dams (reservoirs, detention basins, recharge basins)		
Flow obstructions (culverts, paved stream crossings)		
Weir/drop structure, tide gates		
Dredged inlet/channel		
Engineered channel (riprap, armored channel bank, bed)		
Dike/levees		
Groundwater extraction		
Ditches (borrow, agricultural drainage, mosquito control, etc.)		
Actively managed hydrology	y- culvert outfall at top of AA	
Comments		
Culvert inlet at top of AA, upstream approx 65' of stresam monitoring location. Downstream end of AA has a 60" culvert to allow flow to pass under unpaved road.		

PHYSICAL STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Filling or dumping of sediment or soils **(N/A for restoration areas)**		
Grading/ compaction **(N/A for restoration areas)**		
Plowing/Discing **(N/A for restoration areas)**		
Resource extraction (sediment, gravel, oil and/or gas)		
Vegetation management		
Excessive sediment or organic debris from watershed		
Excessive runoff from watershed		
Nutrient impaired (PS or Non-PS pollution)		
Heavy metal impaired (PS or Non-PS pollution)		
Pesticides or trace organics impaired (PS or Non-PS pollution)		
Bacteria and pathogens impaired (PS or Non-PS pollution)		
Trash or refuse	y- some plastic botttles present	
Comments		

BIOTIC STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Mowing, grazing, excessive herbivory (within AA)		
Excessive human visitation		
Predation and habitat destruction by non-native vertebrates (e.g., *Virginia opossum* and domestic predators, such as feral pets)		
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species		
Pesticide application or vector control		
Biological resource extraction or stocking (fisheries, aquaculture)		
Excessive organic debris in matrix (for vernal pools)		
Lack of vegetation management to conserve natural resources		
Lack of treatment of invasive plants adjacent to AA or buffer		
Comments		

BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (WITHIN 500 M OF AA)	Present	Significant negative effect on AA
Urban residential		
Industrial/commercial	y- active mining	
Military training/Air traffic		
Dams (or other major flow regulation or disruption)		
Dryland farming		
Intensive row-crop agriculture		
Orchards/nurseries		
Commercial feedlots		
Dairies		
Ranching (enclosed livestock grazing or horse paddock or feedlot)		
Transportation corridor		
Rangeland (livestock rangeland also managed for native vegetation)		
Sports fields and urban parklands (golf courses, soccer fields, etc.)		
Passive recreation (bird-watching, hiking, etc.)		
Active recreation (off-road vehicles, mountain biking, hunting, fishing)		
Physical resource extraction (rock, sediment, oil/gas)	y- active mining	
Biological resource extraction (aquaculture, commercial fisheries)		
Comments		

Basic Information Sheet: Riverine Wetlands

Assessment Area Name:	Downstream Discharge Location
Project Name:	Permanente Creek NPDES Study
Assessment Area ID #:	Downstream Discharge Location
Project ID #:	**Date:** 02/ 02 /2018
Assessment Team Members for This AA:	Sarah Norris, Devin Barry
Average Bankfull Width:	
Approximate Length of AA (10 times bankfull width, min 100 m, max 200 m)**:**	100 m
Upstream Point Latitude: 37.31759297	**Longitude:** -122.0876773
Downstream Point Latitude: 37.31910477	**Longitude:** -122.08645981

Wetland Sub-type:

☒ Confined ☐ Non-confined

Trapazoidal concrete-lined channel.

AA Category:

☐ Restoration ☐ Mitigation ☐ Impacted ☐ Ambient ☐ Reference ☐ Training

☒ Other: NPDES Documentation

Did the river/stream have flowing water at the time of the assessment? ☒ yes ☐ no

What is the apparent hydrologic flow regime of the reach you are assessing?

The hydrologic flow regime of a stream describes the frequency with which the channel conducts water. *Perennial* streams conduct water all year long, whereas *ephemeral* streams conduct water only during and immediately following precipitation events. *Intermittent* streams are dry for part of the year, but conduct water for periods longer than ephemeral streams, as a function of watershed size and water source.

☒ perennial ☐ intermittent ☐ ephemeral

1

Photo Identification Numbers and Description:

	Photo ID No.	Description	Latitude	Longitude	Datum
1		Upstream			
2		Middle Left			
3		Middle Right			
4		Downstream			
5					
6					
7					
8					
9					
10					

Site Location Description:

Comments:

Scoring Sheet: Riverine Wetlands

AA Name: Downstream Discharge Location				**Date:** 2/ 02/2018	
Attribute 1: Buffer and Landscape Context (pp. 11-19)				**Comments**	
Stream Corridor Continuity (D)		Alpha. B	Numeric 9		
Buffer:					
Buffer submetric A: Percent of AA with Buffer	Alpha. B	Numeric 9			
Buffer submetric B: Average Buffer Width	B	9			
Buffer submetric C: Buffer Condition	C	6			
Raw Attribute Score = D+[C x (A x B)^{½}]^{½}			16.3	**Final Attribute Score = (Raw Score/24) x 100**	67.9
Attribute 2: Hydrology (pp. 20-26)					
		Alpha.	Numeric		
Water Source		C	6		
Channel Stability		D	3	Trapazoidal concrete-lined channel.	
Hydrologic Connectivity		D	3		
Raw Attribute Score = sum of numeric scores			12	**Final Attribute Score = (Raw Score/36) x 100**	33
Attribute 3: Physical Structure (pp. 27-33)					
		Alpha.	Numeric		
Structural Patch Richness		D	3		
Topographic Complexity		D	3		
Raw Attribute Score = sum of numeric scores			6	**Final Attribute Score = (Raw Score/24) x 100**	25
Attribute 4: Biotic Structure (pp. 34-41)					
Plant Community Composition (based on sub-metrics A-C)					
	Alpha.	Numeric		3 layers (medium, tall, very tall)	
Plant Community submetric A: Number of plant layers	B	9			
Plant Community submetric B: Number of Co-dominant species	D	3		4 co-dom species	
Plant Community submetric C: Percent Invasion	A	12			
Plant Community Composition Metric *(numeric average of submetrics A-C)*			8		
Horizontal Interspersion		D	3		
Vertical Biotic Structure		B	9		
Raw Attribute Score = sum of numeric scores			20	**Final Attribute Score = (Raw Score/36) x 100**	55.6
Overall AA Score (average of four final Attribute Scores)					45.3

3

Worksheet for Stream Corridor Continuity Metric for Riverine Wetlands

Lengths of Non-buffer Segments For Distance of 500 m Upstream of AA		Lengths of Non-buffer Segments For Distance of 500 m Downstream of AA	
Segment No.	Length (m)	Segment No.	Length (m)
1		1	
2		2	
3		3	
4		4	
5		5	
Upstream Total Length	157	Downstream Total Length	16

Percent of AA with Buffer Worksheet

In the space provided below make a quick sketch of the AA, or perform the assessment directly on the aerial imagery; indicate where buffer is present, estimate the percentage of the AA perimeter providing buffer functions, and record the estimate amount in the space provided.

Percent of AA with Buffer: ____ %

Worksheet for calculating average buffer width of AA

Line	Buffer Width (m)
A	250
B	250
C	250
D	250
E	65
F	79
G	80
H	54
Average Buffer Width *Round to the nearest integer*	153

4

Worksheet for Assessing Channel Stability for Riverine Wetlands

Condition	Field Indicators (check all existing conditions)
Indicators of Channel Equilibrium	☐ The channel (or multiple channels in braided systems) has a well-defined bankfull contour that clearly demarcates an obvious active floodplain in the cross-sectional profile of the channel throughout most of the AA. ☐ Perennial riparian vegetation is abundant and well established along the bankfull contour, but not below it. ☐ There is leaf litter, thatch, or wrack in most pools (if pools are present). ☐ The channel contains embedded woody debris of the size and amount consistent with what is naturally available in the riparian area. ☐ There is little or no active undercutting or burial of riparian vegetation. ☐ If mid-channel bars and/or point bars are present, they are not densely vegetated with perennial vegetation. ☐ Channel bars consist of well-sorted bed material (smaller grain size on the top and downstream end of the bar, larger grain size along the margins and upstream end of the bar). ☐ There are channel pools, the spacing between pools tends to be regular and the bed is not planar throughout the AA ☐ The larger bed material supports abundant mosses or periphyton.
Indicators of Active Degradation	☐ The channel is characterized by deeply undercut banks with exposed living roots of trees or shrubs. ☐ There are abundant bank slides or slumps. ☐ The lower banks are uniformly scoured and not vegetated. ☐ Riparian vegetation is declining in stature or vigor, or many riparian trees and shrubs along the banks are leaning or falling into the channel. ☐ An obvious historical floodplain has recently been abandoned, as indicated by the age structure of its riparian vegetation. ☐ The channel bed appears scoured to bedrock or dense clay. ☐ Recently active flow pathways appear to have coalesced into one channel (i.e. a previously braided system is no longer braided). ☐ The channel has one or more knickpoints indicating headward erosion of the bed.
Indicators of Active Aggradation	☐ There is an active floodplain with fresh splays of coarse sediment (sand and larger that is not vegetated) deposited in the current or previous year. ☐ There are partially buried living tree trunks or shrubs along the banks. ☐ The bed is planar (flat or uniform gradient) overall; it lacks well-defined channel pools, or they are uncommon and irregularly spaced. ☐ There are partially buried, or sediment-choked, culverts. ☐ Perennial terrestrial or riparian vegetation is encroaching into the channel or onto channel bars below the bankfull contour. ☐ There are avulsion channels on the floodplain or adjacent valley floor.
Overall	☐ **Equilibrium** ☐ **Degradation** ☐ **Aggradation**

Trapazoidal concrete-lined channel.

5

Riverine Wetland Entrenchment Ratio Calculation Worksheet

The following 5 steps should be conducted for each of 3 cross-sections located in the AA at the approximate midpoints along straight riffles or glides, away from deep pools or meander bends. An attempt should be made to place them at the top, middle, and bottom of the AA.				
Steps	**Replicate Cross-sections** →	**TOP**	**MID**	**BOT**
1 Estimate bankfull width.	This is a critical step requiring familiarity with field indicators of the bankfull contour. Estimate or measure the distance between the right and left bankfull contours.	10'	10'	10'
2: Estimate max. bankfull depth.	Imagine a level line between the right and left bankfull contours; estimate or measure the height of the line above the thalweg (the deepest part of the channel).	12"	12"	12"
3: Estimate flood prone depth.	Double the estimate of maximum bankfull depth from Step 2.	24"	24"	24"
4: Estimate flood prone width.	Imagine a level line having a height equal to the flood prone depth from Step 3; note where the line intercepts the right and left banks; estimate or measure the length of this line.			
5: Calculate entrenchment ratio.	Divide the flood prone width (Step 4) by the bankfull width (Step 1).			
6: Calculate average entrenchment ratio.	Calculate the average results for Step 5 for all 3 replicate cross-sections. Enter the average result here and use it in Table 13a or 13b.			

Trapazoidal concrete-lined channel.

Structural Patch Type Worksheet for Riverine wetlands

Circle each type of patch that is observed in the AA and enter the total number of observed patches in Table below. In the case of riverine wetlands, their status as confined or non-confined must first be determined (see page 6) to determine with patches are expected in the system (indicated by a "1" in the table below). Any feature onsite should only be counted once as a patch type. If a feature appears to meet the definition of more than one patch type (i.e. swale and secondary channel) the practitioner should choose which patch type best illustrates the feature. Not all features at a site will be patch types.

Please refer to the CRAM Photo Dictionary at** www.cramwetlands.org **for photos of each of the following patch types.

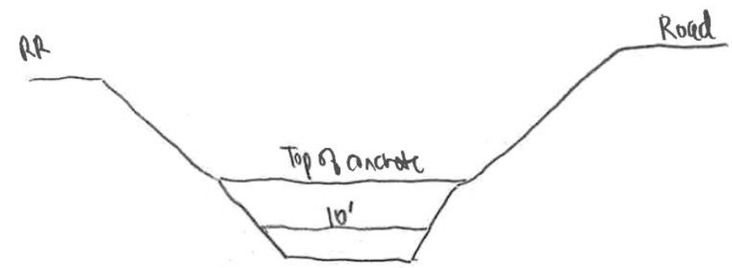
STRUCTURAL PATCH TYPE (circle for presence)	Riverine (Non-confined)	Riverine (Confined)	
Minimum Patch Size	**3 m^2**	**3 m^2**	
Abundant wrackline or organic debris in channel, on floodplain	1	1	
Bank slumps or undercut banks in channels or along shoreline	1	1	
Cobbles and/or Boulders	1	1	
Debris jams	1	1	
Filamentous macroalgae or algal mats	1	1	
Large woody debris	1	1	
Pannes or pools on floodplain	1	N/A	
Plant hummocks and/or sediment mounds	1	1	
Point bars and in-channel bars	1	1	
Pools or depressions in channels (wet or dry channels)	1	1	
Riffles or rapids (wet or dry channels)	1	1	Artifical log jams in channel.
Secondary channels on floodplains or along shorelines	1	N/A	
Standing snags (at least 3 m tall)	1	1	
Submerged vegetation	1	N/A	
Swales on floodplain or along shoreline	1	N/A	
Variegated, convoluted, or crenulated foreshore (instead of broadly arcuate or mostly straight)	1	1	
Vegetated islands (mostly above high-water)	1	N/A	
Total Possible	17	12	
No. Observed Patch Types (enter here and use in Table 14 below)		3	

7

Worksheet for AA Topographic Complexity

At three locations along the AA, make a sketch of the profile of the stream from the AA boundary down to its deepest area then back out to the other AA boundary. Try to capture the benches and the intervening micro-topographic relief. To maintain consistency, make drawings at each of the stream hydrologic connectivity measurements, always facing downstream. Include the water level, an arrow at the bankfull contour, and label the benches. Based on these sketches and the profiles in Figure 10, choose a description in Table 16 that best describes the overall topographic complexity of the AA.

Profile 1



Profile 2

Profile consistent throughout length of AA

Profile 3

8

Plant Community Metric Worksheet: Co-dominant species richness for Riverine wetlands
(A dominant species represents ≥10% ***relative*** cover)

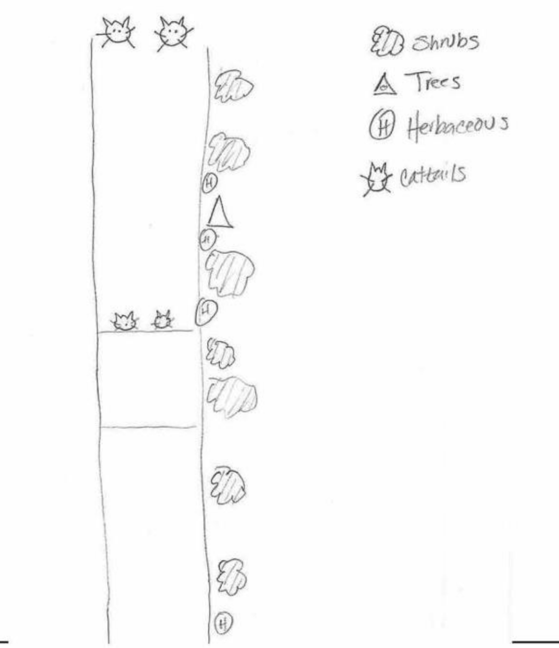
Special Note:

* *Combine the counts of co-dominant species from all layers to identify the total species count. Each plant species is only counted once when calculating the Number of Co-dominant Species and Percent Invasion submetric scores, regardless of the numbers of layers in which it occurs.*

Floating or Canopy-forming (non-confined only)	Invasive?	Short (<0.5 m)	Invasive?
		Urtica dioica (**) denotes less than	10% cover
		Agrostis (**) denotes less than	10% cover
Medium (0.5-1.5 m)	**Invasive?**	**Tall (1.5-3.0 m)**	**Invasive?**
Baccharis pilularis		Typha angustifolia	
Heteromeles arbutifolia			
Very Tall (>3.0 m)	**Invasive?**	Total number of co-dominant species for all layers combined (enter here and use in Table 18)	4
Quercus agrifolia			
		Percent Invasion *Round to the nearest integer* (enter here and use in Table 18)	0

Horizontal Interspersion Worksheet.

Use the spaces below to make a quick sketch of the AA in plan view, outlining the major plant zones (this should take no longer than 10 minutes). Assign the zones names and record them on the right. Based on the sketch, choose a single profile from Figure 12 that best represents the AA overall.



Assigned zones:

1)

2)

3)

4)

5)

6)

Worksheet for Wetland disturbances and conversions

Has a major disturbance occurred at this wetland?	Yes	No		
If yes, was it a flood, fire, landslide, or other?	flood	fire	landslide	other
If yes, then how severe is the disturbance?	likely to affect site next 5 or more years	likely to affect site next 3-5 years	likely to affect site next 1-2 years	
Has this wetland been converted from another type? If yes, then what was the previous type?	depressional	vernal pool	vernal pool system	
	non-confined riverine	confined riverine	seasonal estuarine	
	perennial saline estuarine	perennial non-saline estuarine	wet meadow	
	lacustrine	seep or spring	playa	

10

Stressor Checklist Worksheet

HYDROLOGY ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Point Source (PS) discharges (POTW, other non-stormwater discharge)	y	
Non-point Source (Non-PS) discharges (urban runoff, farm drainage)		
Flow diversions or unnatural inflows		
Dams (reservoirs, detention basins, recharge basins)		
Flow obstructions (culverts, paved stream crossings)		
Weir/drop structure, tide gates		
Dredged inlet/channel		
Engineered channel (riprap, armored channel bank, bed)	y- artifically maintained	
Dike/levees		
Groundwater extraction		
Ditches (borrow, agricultural drainage, mosquito control, etc.)		
Actively managed hydrology	y	
Comments		

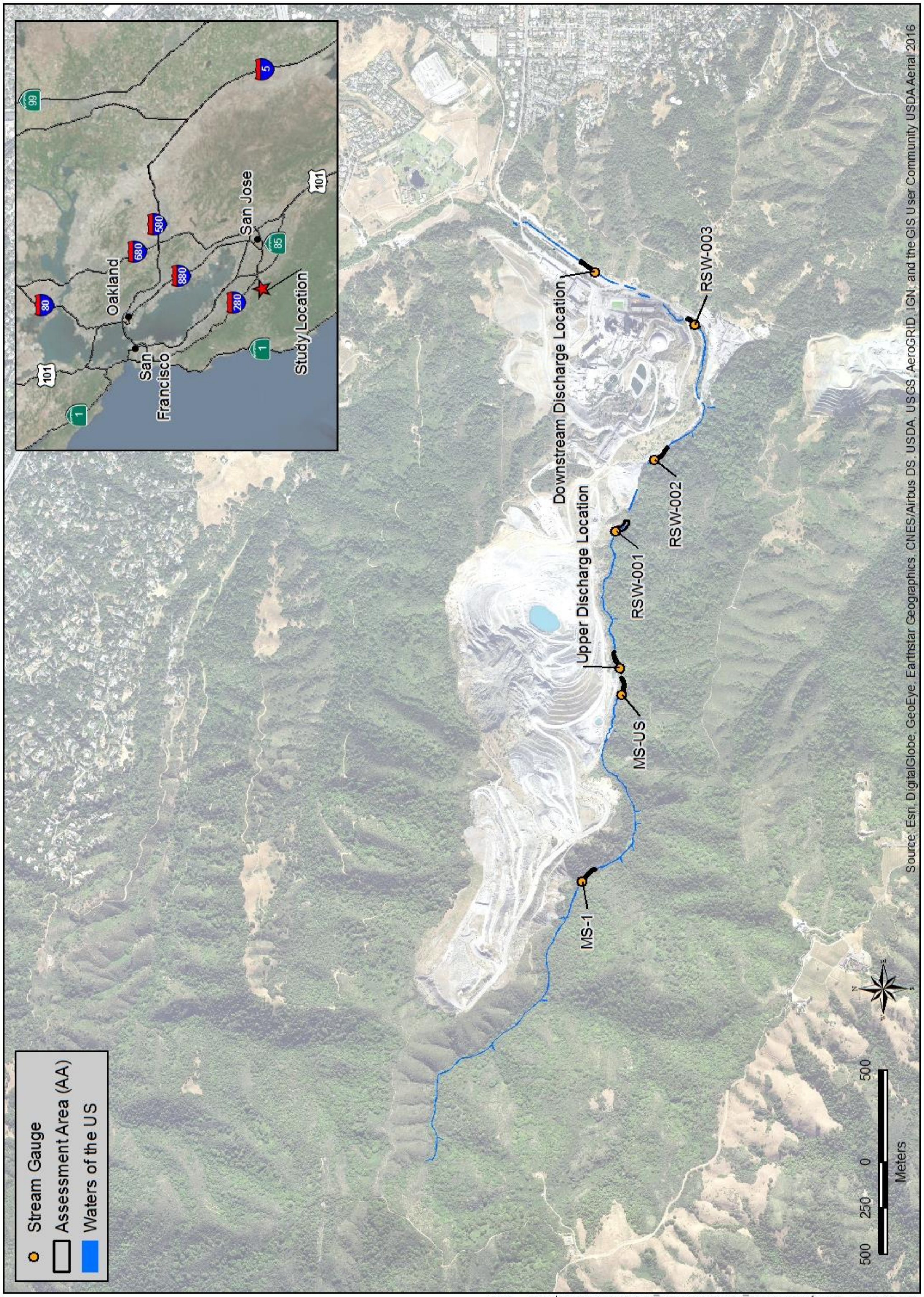
PHYSICAL STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Filling or dumping of sediment or soils **(N/A for restoration areas)**		
Grading/ compaction **(N/A for restoration areas)**		
Plowing/Discing **(N/A for restoration areas)**		
Resource extraction (sediment, gravel, oil and/or gas)		
Vegetation management		
Excessive sediment or organic debris from watershed		
Excessive runoff from watershed	y- erosion in-channel from steep side slopes above channel.	
Nutrient impaired (PS or Non-PS pollution)		
Heavy metal impaired (PS or Non-PS pollution)		
Pesticides or trace organics impaired (PS or Non-PS pollution)		
Bacteria and pathogens impaired (PS or Non-PS pollution)		
Trash or refuse		
Comments		

11

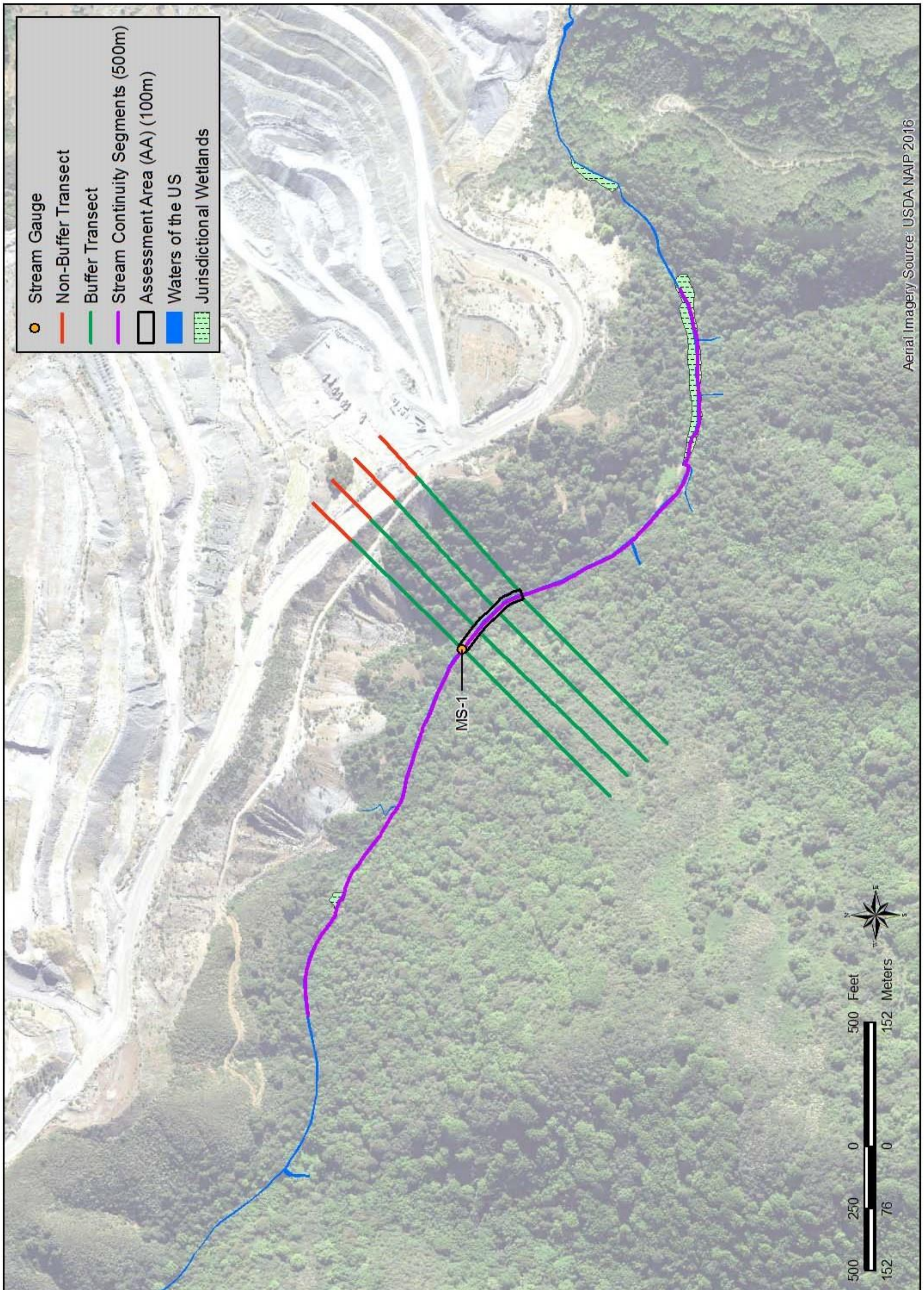
BIOTIC STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Mowing, grazing, excessive herbivory (within AA)		
Excessive human visitation		
Predation and habitat destruction by non-native vertebrates (e.g., *Virginia opossum* and domestic predators, such as feral pets)		
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species		
Pesticide application or vector control		
Biological resource extraction or stocking (fisheries, aquaculture)		
Excessive organic debris in matrix (for vernal pools)		
Lack of vegetation management to conserve natural resources		
Lack of treatment of invasive plants adjacent to AA or buffer		
Comments		

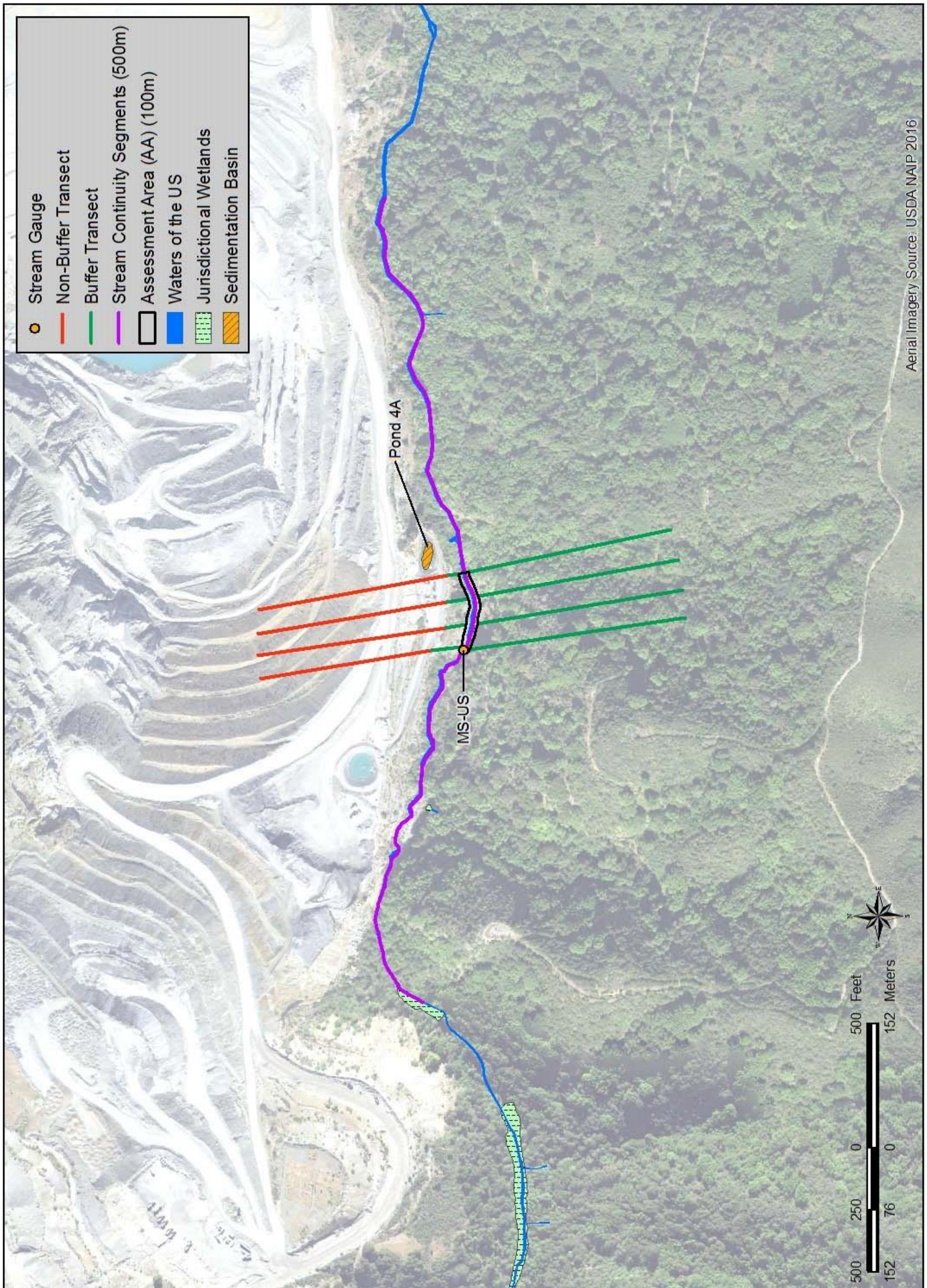
BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (WITHIN 500 M OF AA)	Present	Significant negative effect on AA
Urban residential		
Industrial/commercial	y- active mining, adjacent road	
Military training/Air traffic		
Dams (or other major flow regulation or disruption)		
Dryland farming		
Intensive row-crop agriculture		
Orchards/nurseries		
Commercial feedlots		
Dairies		
Ranching (enclosed livestock grazing or horse paddock or feedlot)		
Transportation corridor		
Rangeland (livestock rangeland also managed for native vegetation)		
Sports fields and urban parklands (golf courses, soccer fields, etc.)		
Passive recreation (bird-watching, hiking, etc.)		
Active recreation (off-road vehicles, mountain biking, hunting, fishing)		
Physical resource extraction (rock, sediment, oil/gas)	y- active mining	
Biological resource extraction (aquaculture, commercial fisheries)		
Comments		

Appendix B. Buffer and Landscape Figures for Assessment Areas

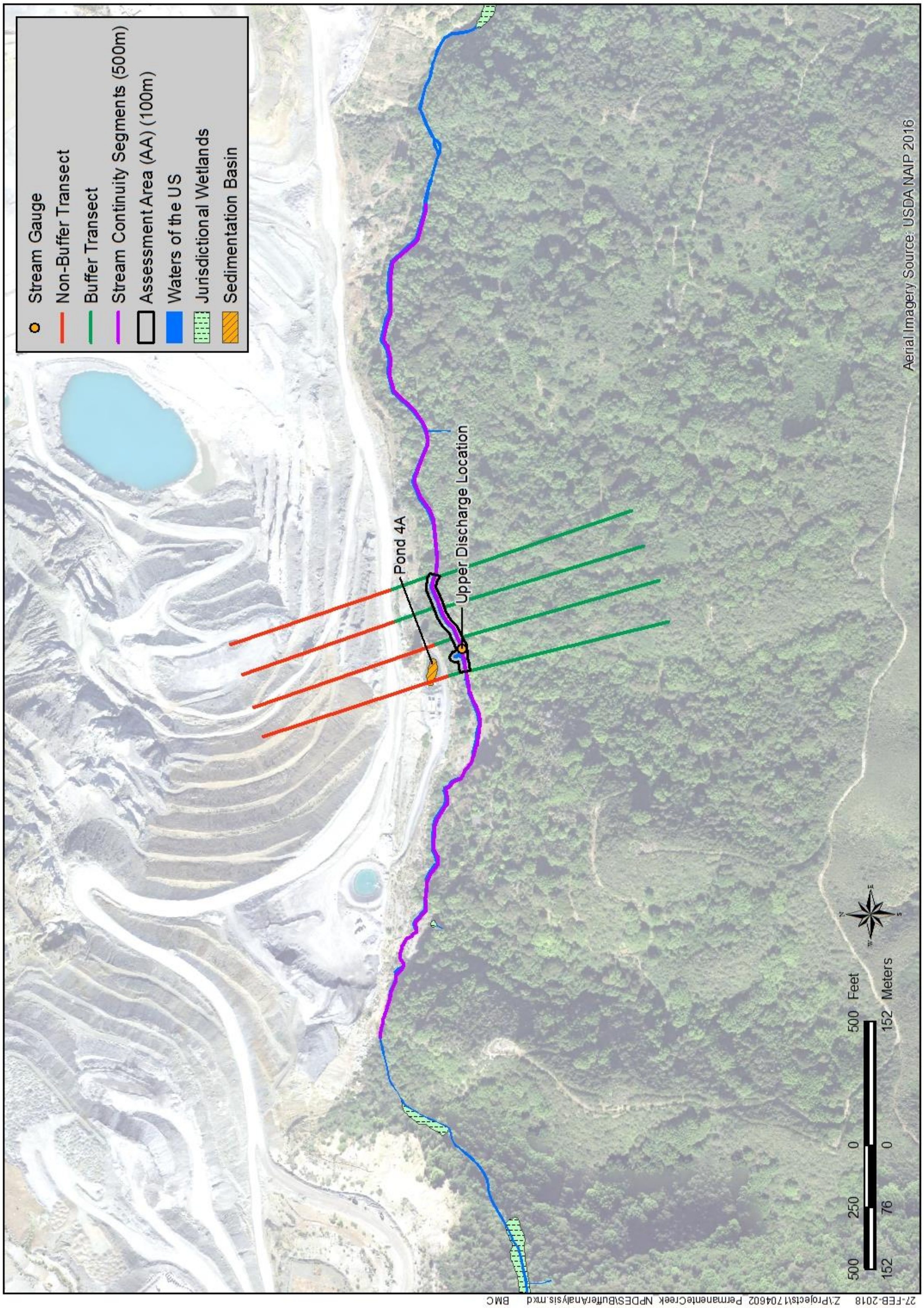


27-FEB-2018 Z:\Projects\1704602_PermanenteCreek_NPDES\OverviewMap.mxd BMC

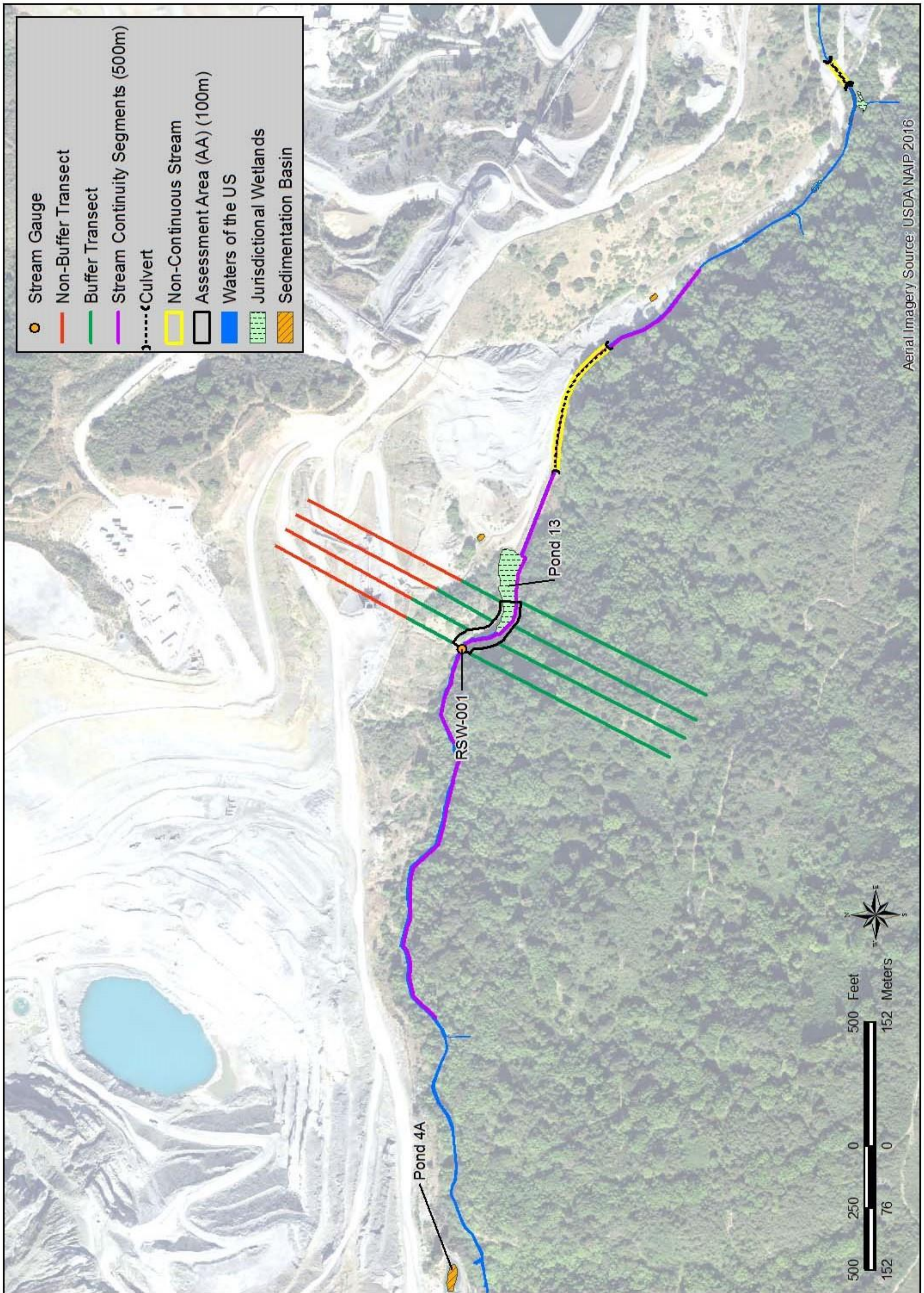

Stream Gauge
Non-Buffer Transect
Buffer Transect
Stream Continuity Segments (500m)
Assessment Area (AA) (100m)
Waters of the US
Jurisdictional Wetlands
MS-1
Aerial Imagery Source: USDA NAIP 2016
500 250 0 500 Feet
152 76 0 152 Meters
15-FEB-2018 Z:\Projects\1704602_PermanenteCreek_NPDES\BufferAnalysis.mxd BMC



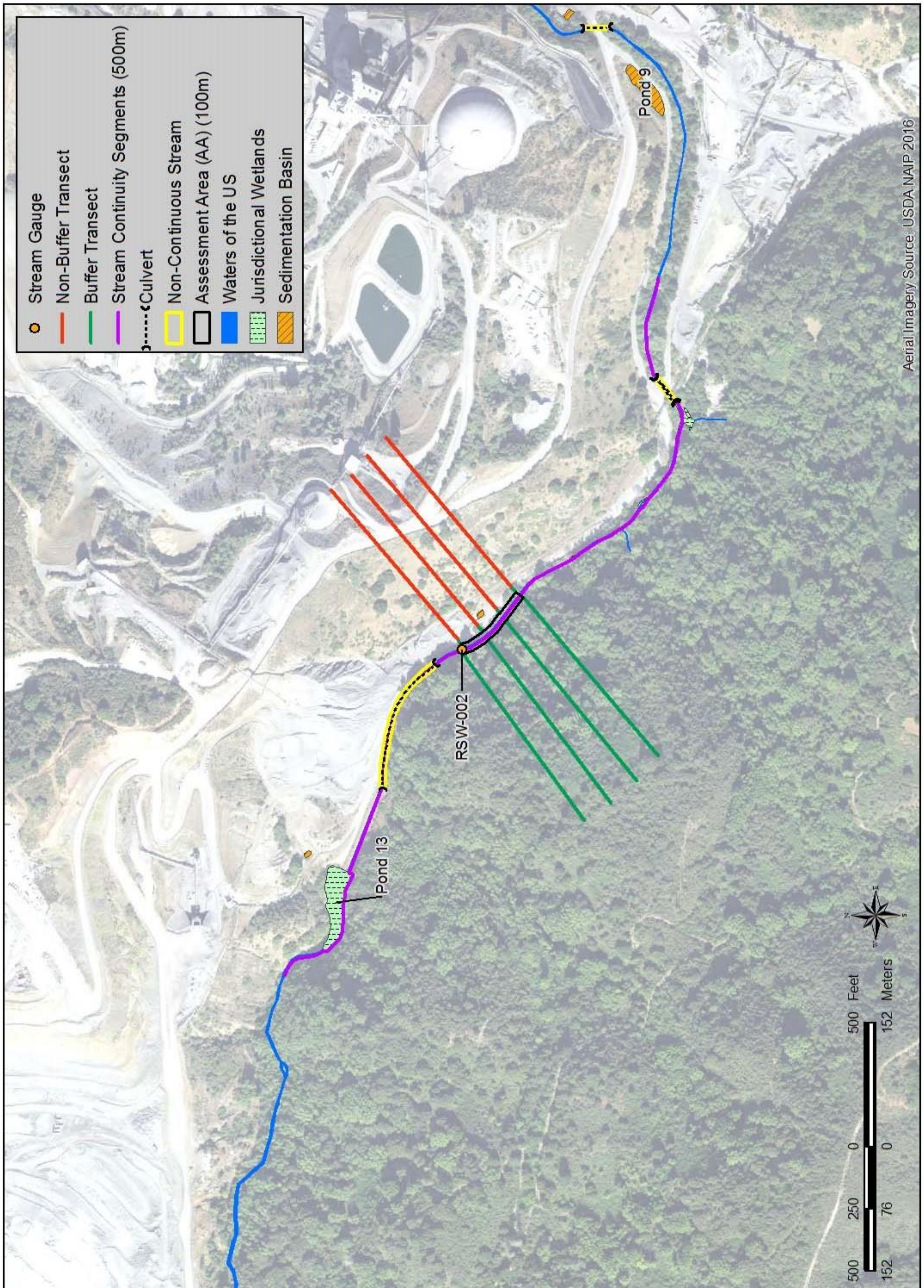
15-FEB-2018 Z:\Projects\1704602_PermanenteCreek_NPDES\BufferAnalysis.mxd BMC

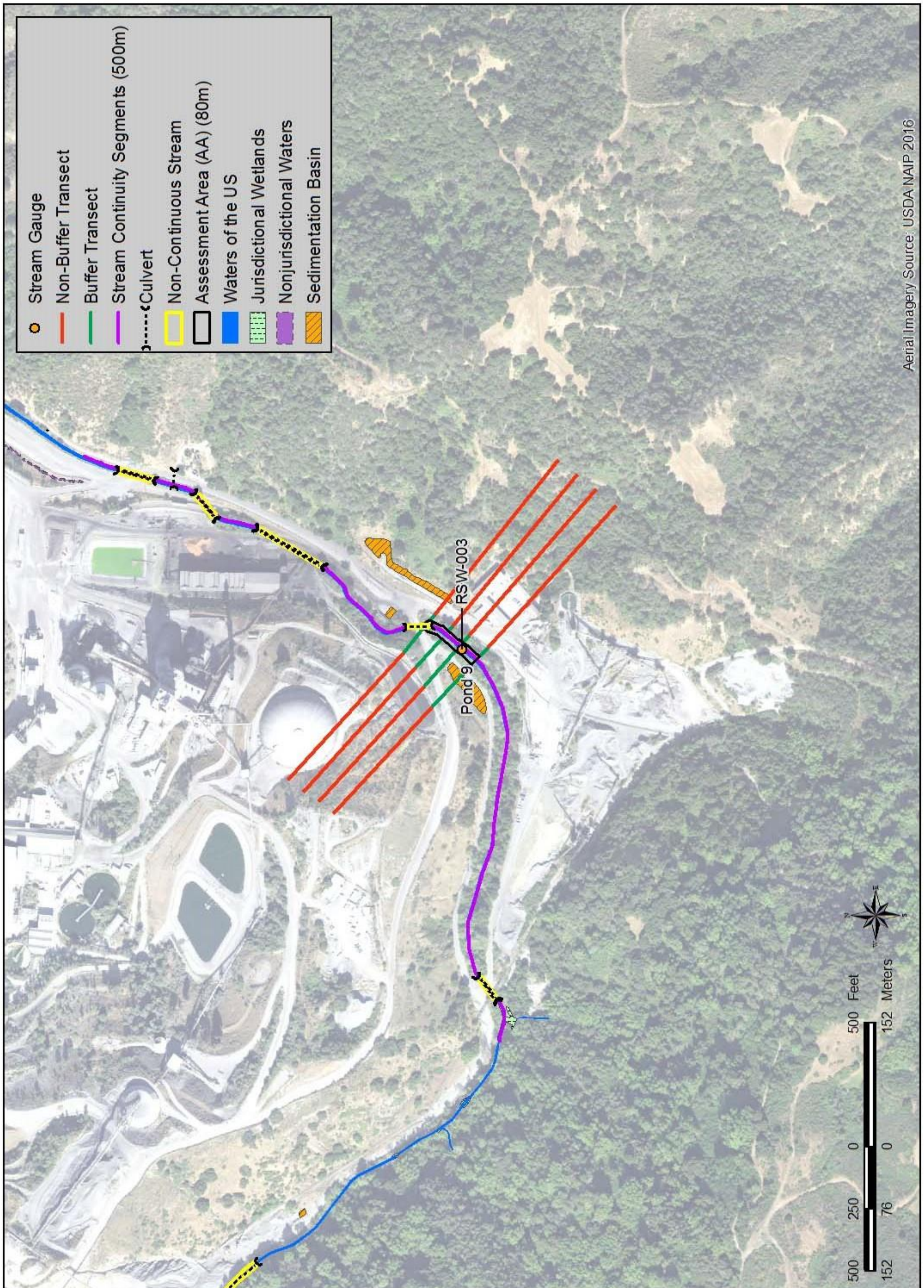


Stream Gauge
Non-Buffer Transect
Buffer Transect
Stream Continuity Segments (500m)
Assessment Area (AA) (100m)
Waters of the US
Jurisdictional Wetlands
Sedimentation Basin
Pond 4A
Upper Discharge Location
Aerial Imagery Source: USDA NAIP 2016
500 250 0 500 Feet
152 76 0 152 Meters
27-FEB-2018 Z:\Projects\1704602_PermanenteCreek_NPDES\BufferAnalysis.mxd BMC

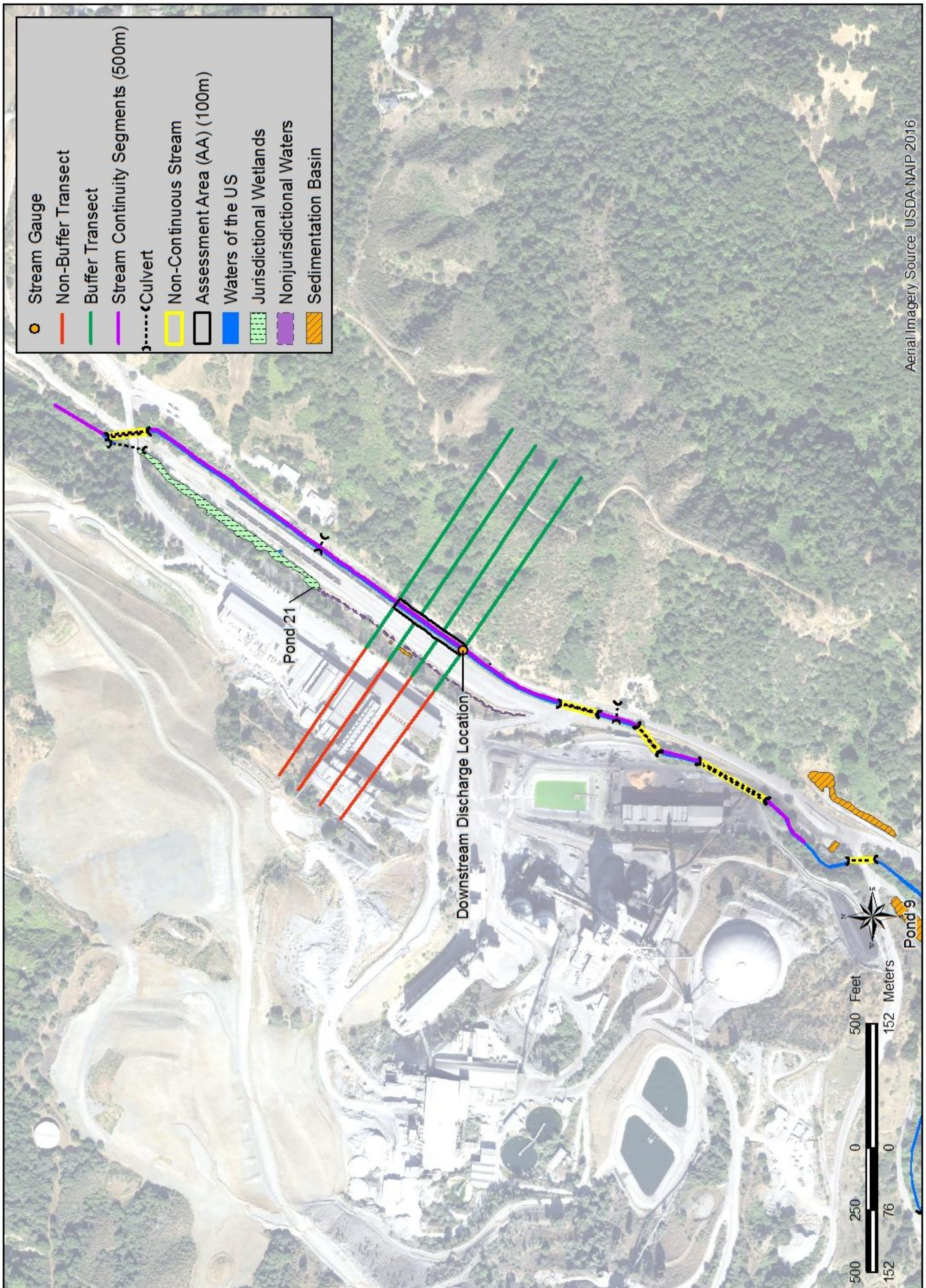


15-FEB-2018 Z:\Projects\1704602_PermanenteCreek_NPDES\BufferAnalysis.mxd BMC


Stream Gauge
Non-Buffer Transect
Buffer Transect
Stream Continuity Segments (500m)
Culvert
Non-Continuous Stream
Assessment Area (AA) (100m)
Waters of the US
Jurisdictional Wetlands
Sedimentation Basin
Pond 9
Pond 13
RSW-002
Aerial Imagery Source: USDA NAIP 2016
500 Feet
152 Meters
0
250
76
500
152



15-FEB-2018 Z:\Projects\1704602_PermanenteCreek_NPDES\BufferAnalysis.mxd BMC



27-FEB-2018 Z:\Projects\1704602_PermanenteCreek_NPDES\BufferAnalysis.mxd BMC

Appendix C. Photographs of CRAM Assessment Areas


Photograph 1. Downstream end of MS-1 Assessment Area facing upstream.


Photograph 2. Upstream end of MS-US Assessment Area facing downstream.

Photograph 3. Upstream end of Upper Discharge Location Assessment Area facing downstream.

Photograph 4. Upstream end of RSW-01 Assessment Area facing upstream.


Photograph 5. Downstream end of RSW-001 Assessment Area facing downstream.


Photograph 6. Half-culvert present downstream of RSW-001 Assessment Area.

Photograph 7. Upstream end of RSW-002 Assessment Area facing downstream.

Photograph 8. Downstream end of RSW-002 Assessment Area facing downstream.

Photograph 9. Downstream end of RSW-003 Assessment Areas facing upstream.

Photograph 10. Upstream end of Proposed Discharge Location Assessment Area facing downstream.

This page intentionally left blank.